

VEGETABLE FOES

A Description of the various Insect, Animal and Fungal
Pests that attack Vegetable Crops, with Remedies
for their Prevention and Eradication

BY

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(*Editor of "Amateur Gardening"; Author of "Vegetables and
their Cultivation," "Fruit Foes," etc., etc.*)

THIRTY-FOUR FOES PICTURED IN COLOUR

*Specially drawn by Kate Ashley, under the supervision of
Dr. J C Gahan, M.A., Keeper of the Entomological
Dept., Natural History Museum*

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FOREWORDS.

"WHAT is wrong with my vegetables?" "How can I cure their diseases?" "How can I protect them against the ravages of insects?" These are questions that cultivators are always asking in varying forms. And the answer to the perplexed gardener in all these matters will be found in this book, which is the second of a series of three volumes dealing with the gardener's enemies.

"Fruit Foes," the first of the series, has already been published and showed clearly that it instantly met a long felt want. "Flower Foes," the final book of the series, will be published shortly.

"Vegetable Foes" describes in a fairly comprehensive manner the life histories of the various pests and diseases that are injurious to vegetable food crops, points out the special harm they do to each, and gives practical and sound advice regarding the most efficient remedies to apply as a means of prevention or eradication. Forearmed with the knowledge conveyed in this volume the grower should be able to circumvent the mischievous activities of his enemies below and above ground and ensure healthy and successful crops.

The scientific and practical value of this series of handbooks is greatly enhanced by the unique coloured plates, prepared from colour drawings specially made for "Amateur Gardening" by the late Miss Kate Ashley, under the friendly supervision of Dr. J. C. Gahan, M.A., Keeper of the Entomological Department of the Natural History Museum. In each case the artist has faithfully delineated the pest in a life-like manner, showing the parent, its larva, pupa and ova as far as possible of natural size in association with the particular vegetable it mainly attacks.

FOREWORDS.

Thus the reader is able to visualise the life history of each pest. Unfortunately Miss Ashley died before she could complete the commission we gave her, otherwise the collection of colour drawings would have been even greater in number than it is now.

As the list of contents of the following pages clearly testifies the work contains a description of every pest or disease known to be seriously harmful to vegetable crops. Some of them, it is true, are not so destructive as others, but it is well, nevertheless, that growers should be acquainted with the minor as well as the major forms of vegetable vermin. Those, however, portrayed in the coloured plates may be regarded as formidable foes.

In the text will be found outline drawings of many important pests and diseases, while others are illustrated in monochrome plates. These, with the seventeen coloured plates, depicting thirty-four pests, will enable the reader to identify the chief enemies of crops with comparative ease.

Finally, every effort has been made to give the up-to-date nomenclature of the pests and diseases, to accurately describe their respective life histories, and to supply efficient remedies for their prevention or eradication. Thus we trust the book will not fail in its mission of rendering practical service to growers of vegetable crops.

T. W. S.

London, 1922.

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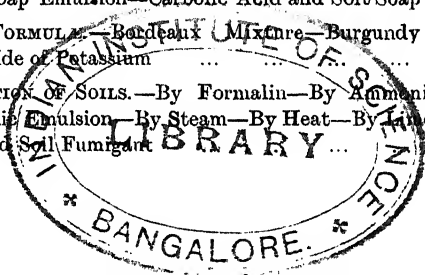
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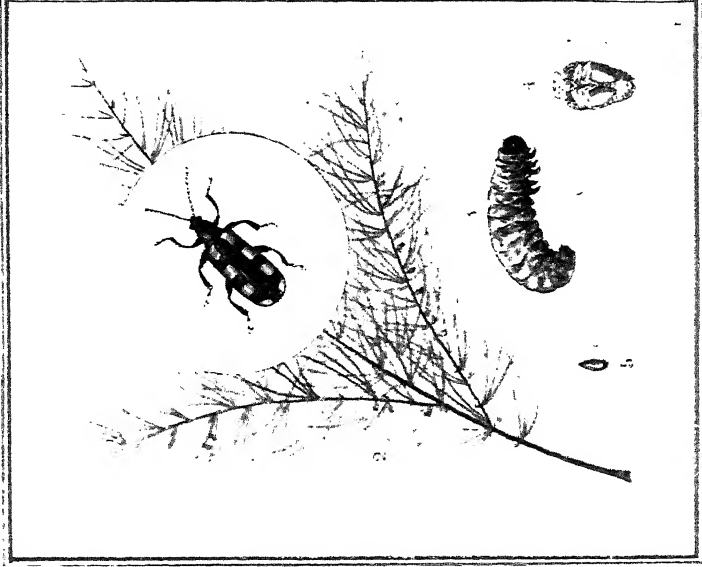
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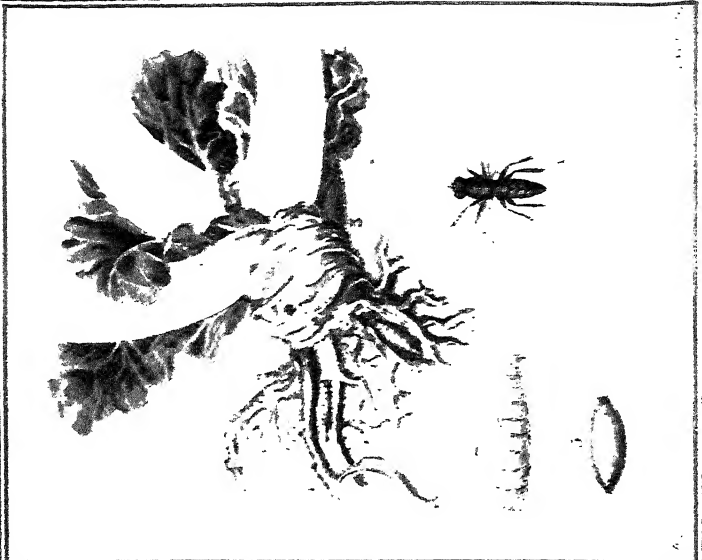


ASPARAGUS BEETLE

(CRUCIFERAE ASPARAGI)

1. Beetle (magnified). 2. Beetles feeding. 3. Larva (much magnified). 4. Pupa (magnified). 5. Egg (magnified).

(See p. 9.)



CABBAGE ROOT FLY

(DIPTERA BRASSICAE)

1. Fly (magnified). 2. Larva or maggot (magnified). 3. Maggot at work on a cabbage root. 4. Eggs.

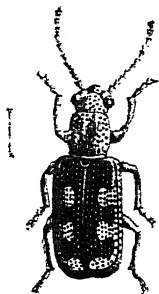
(See p. 21.)

VEGETABLE FOES.

Part I.—PESTS AND DISEASES.

ASPARAGUS.

Asparagus Beetle (*Crioceris asparagi*).—This is a most destructive insect pest. The beetle averages one-quarter of an inch in length and is of a bluish-black colour. The beetles may often be seen about the beds while the asparagus is being cut, and every one should be killed. One beetle will lay hundreds of spindle-shaped eggs on



ASPARAGUS BEETLE
(*CRIOCERIS ASPARAGI*).

Fully grown beetles average $\frac{1}{4}$ in. in length. The larvæ figured natural size. Appear in June.



the stems and leaves from June onwards; the eggs hatch out in a few days, and the greenish-grey wrinkled skinned larvæ commence eating the leaves, leaving nothing but bare stems. When plants are badly infested no good asparagus will be produced from the crowns the following year. The larvæ become fully fed in about twelve days, then they pupate in the soil and appear as beetles in two to three weeks. The beetles hibernate in the soil during the winter. Two and three broods appear in a season.

REMEDIES.—The best way of destroying the larvæ is to poison the leaves they are eating. This may be accomplished by spraying the foliage with an arsenate of lead paste wash directly cutting of the shoots has ceased. The lead solution is poisonous, so must not be used whilst cutting is in progress.

Asparagus Fly (*Platyparæa pæcilopectera*).—An insect about the size of an ordinary house-fly with a reddish head, a grey thorax, and a dark brown body, and wings marked with dark brown transverse bars. It usually appears early in May and then deposits its eggs on the shoots. In about a fortnight yellowish white maggots appear and commence to eat their way into the shoots, causing them to become distorted and unhealthy. The maggots pupate in the stems about July or August.

REMEDIES.—Cut off close to the ground in August all distorted or sickly looking shoots and burn them so as to destroy the pupæ within.

Asparagus Rust (*Puccinia asparagi*). — This fungus disease has committed terrible havoc among the asparagus crop, especially in the Evesham district. It attacks the plants late in the year, and causes the shoots to turn black. The disease seriously weakens the growth of the plant, and ultimately kills it. It is more prevalent in moist than dry seasons. It appears first in the form of blister-like spots on the epidermis of the shoots, these eventually turning to a brown rusty colour, and then becoming black.

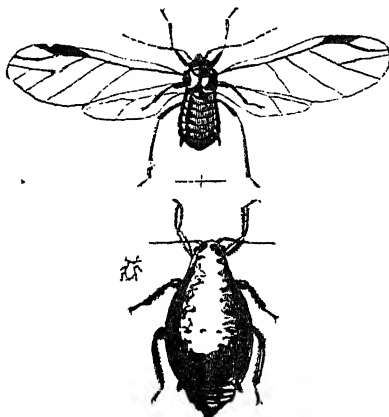
REMEDIES.—Spray the foliage every ten days during the summer with Woburn Bordeaux Paste Emulsion; this acts as a certain preventive against attack. In the event of plants being infected the proper remedy is to cut off the foliage and burn it.

Asparagus Root Disease (*Rhizoctonia medicaginis*).—A disease which attacks the roots of clover and asparagus, as well as other wild and cultivated plants in a lesser degree. It appears on the roots in the form of a close web of violet-coloured, filamentous growth, and causes the roots to wither, rot, and die.

REMEDIES.—The only one is to dig up and burn the diseased roots.

BEAN.

Bean Aphis, or Dolphin Fly (*Aphis rumicis*).—Besides the names given above, this pest is also known as the "Collier," "Black Fly," and "Black Dolphin." Briefly its life history is as follows: Oviparous females deposit their eggs on wild docks or thistles in autumn. In spring these give birth to viviparous females called "Mother Queens," which reproduce live lice. The latter then proceed to pierce the cuticle of the shoots with their



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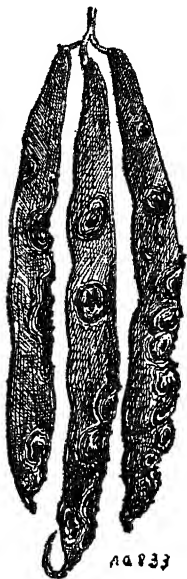
THE BEAN APHIS (*APHIS RUMICIS*).

Commonly known as the "Collier" and "Black Dolphin Fly." Infests the young shoots of the broad, runner and kidney Bean. Natural size and magnified.

"beak" or proboscis, and suck out the sap. After three generations of lice are produced another generation of winged and wingless females appear, the former flying off to other plants and the latter remaining on the beans and producing other young. As many as seven generations of lice are produced in one season, each "Mother Queen" being reputed to be the progenitor of no less than 729,000,000 of lice. Not only do these lice seriously damage the tissues of the shoots, but also cover the latter

with a film of honeydew, which with the cast off skins of the lice, render the leaves filthy and unable to carry out their proper functions. The lice infest the broad, kidney, and runner bean. See Coloured Plate.

REMEDIES.—A point should be made of destroying all docks and thistles in the neighbourhood to prevent egg laying in autumn. The soft ends of the shoots should be ripped off directly the plants begin to flower. The ends or tops, if cooked, make an excellent substitute for spinach. Should the plants be infested boil 4 oz. of soft soap in a gallon of water until it is dissolved, then add a wine glass



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BEAN POD CANKER.

A fungus disease named *Colletotrichum lindemuthianum*, which develops dark scales on the pods of runner and kidney beans.

full of paraffin, mix thoroughly and when cold spray the plants with it. Two sprayings usually suffice.

Bean and Pea Rust.—Two species of *Uromyces* (Rust Fungi) attack the foliage of the Broad Bean, Runner and French Bean, and Peas. *U. appendiculatus* attacks the Broad Bean in the form of whitish spots on the leaves



BUFF ERMINE MOTH

(GALLERIA MELLONELLA)

1. The Moth.
2. Caterpillar on Larva.
3. Chrysalis or Pupa.
4. Cocoon.
5. Cluster of Eggs laid on a Spinach leaf. All natural size.

(See p. 84.)



BLACK DOLPHIN APHIS

(APHIS ACUMINATA)

1. Aphid (naturally magnified).
2. Aphid (natural size).
3. Infested shoots of Broad Bean.
4. Winged form of Aphid.

(See p. 11.)

and stems in early spring; later brown pustules freely appear. *U. pisi* occasionally attacks peas. The result of the presence of these parasitic fungi is unhealthy crippled growth.

REMEDIES.—Collecting and burning the infested haulm appears to be the only known remedy for these diseases.

Bean Pod Canker or Anthracnose (*Colletotrichium Lindemuthianum*).—The pods of runner and kidney beans are now and then attacked by a disease which appears in the form of dark-coloured specks encircled by a reddish line. These spots increase in size, form depressions in the surface, and eventually become covered with a white fungoid growth. The disease often appears on the stems, and when it encircles the latter the upper part of the shoot dies. Beans so attacked are worthless for food. Also said to attack cucumber and marrow fruits.

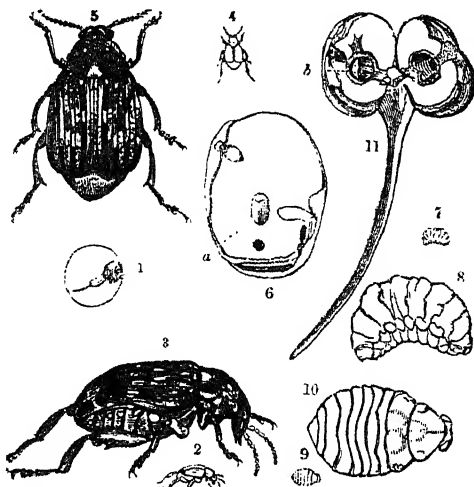
REMEDIES.—Burn infected plants and pods. Do not save seed from infected plants. Spray the plants before flowering with Bordeaux Mixture half its normal strength, and, when the pods appear, with a solution of one ounce of sulphide of potassium to four gallons of water as a preventive remedy.

Bean Seed Beetle (*Bruchus rufimanus*).—The beetle is a small black insect which deposits eggs in the flowers of the broad bean, and these give birth to yellowish-white maggots which enter the young pods and feed on the interior of the seeds. When fully fed the larvæ change to pupæ in the seeds and remain there for a time and then escape in spring through a hole made in the skin.

REMEDIES.—Same as advised for the Pea Beetle.

A New Bean Beetle.—According to the Ministry of Agriculture, a Bean Beetle (*Bruchus obtectus*), which is a serious pest in North America and other parts of the world, has recently been detected in packets of "Canadian Wonder" beans, and it is important that beans containing the live insects should not be planted. The beetle damages the beans in much the same way as the British Bean Beetles, but it is a more dangerous enemy, since it can attack dry beans in store, as well as those in the pod. The signs of attack are: (1) the presence of a clean-cut,

perfectly circular hole in the bean. In this case the beetle has already left the bean, which may, if necessary, be sown, though the risks of failure are greater than with sound beans; (2) a circular depression in the skin of the bean, which can easily be penetrated with the point of a knife showing the beetle underneath. Unless the beetle is



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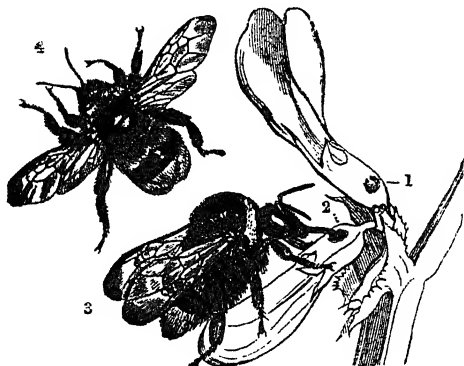
BEAN AND PEA BEETLES.

1. Beetle inside of a pea seed. 2. Pea Beetle (*Bruchus pisi*), natural size. 3. Ditto, magnified. 4. Bean Beetle (*Bruchus rufimanus*), natural size. 5. Ditto, magnified. 6. Bean seed split open, showing cell (a). 7. Larva, natural size. 8. Ditto, magnified. 9. Pupa, natural size. 10. Ditto, magnified. 11. Germinated bean seed containing beetle.

killed such beans must not be planted and should be destroyed.

REMEDIES.—In the case of small quantities of beans, the seeds must be picked over and all those attacked by the beetle destroyed. Either English or foreign Bean Beetles may be found in beans of most varieties. No attempt need be made to distinguish between them since no beans containing live beetles should be sown.

Humble Bee (*Bombus terrestris*).—This and one or two other species of Humble Bees occasionally do harm to the blossoms of the Broad Bean, by boring holes in the calyces in search of the honey or nectar within, during which operation they often injure the organs of fructification and thus prevent pods forming. It is seldom, however, that the damage done is very serious. In the case of the clover family they do more good than harm, as by means of their long tongues they, when collecting the honey, also fer-



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HUMBLE BEES (*BOMBUS TERRESTRIS*).

1. Hole punctured in the calyx of a broad bean flower by bee. 2. Bee inserting his proboscis in search of honey. 3. Bee at work. 4. Bee flying (natural size).

utilise the stigmas. They form their nests in cavities in sunny hedge-banks, appear in early spring, and are most industrious in collecting honey and pollen for feeding their young. Many of them get so exhausted in their labours that they sleep in the blossoms all night and do not return to their nests until the morning. The males have no stings.

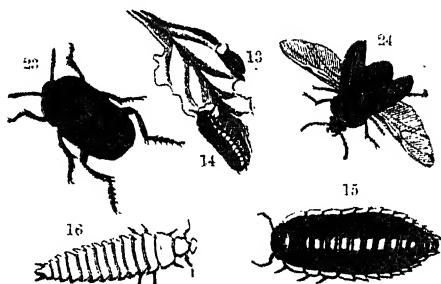
REMEDIES.—If they become too numerous and attack Broad Beans too freely, destroying their nests is the only way of dealing with them. See Wasps.

Other Pests.—See also Snails, Slugs, and Millepedes.

BEET.

Beet Carrion Beetle (*Silpha opaca*).—This is a small black beetle barely half an inch long, and covered with yellow hairs. It is a common pest, frequently met with feeding on dead animals; hence its common name. The grubs or larvæ are, however, the most mischievous, these feeding freely on the leaves of beet. They appear in May, are black and shiny, like a woodlouse in shape, and a third to half an inch in length. See Coloured Plate.

REMEDIES.—Spray infested foliage with arsenate of lead paste to kill the larvæ, and dig in a soil fumigant in autumn to destroy the pupæ.

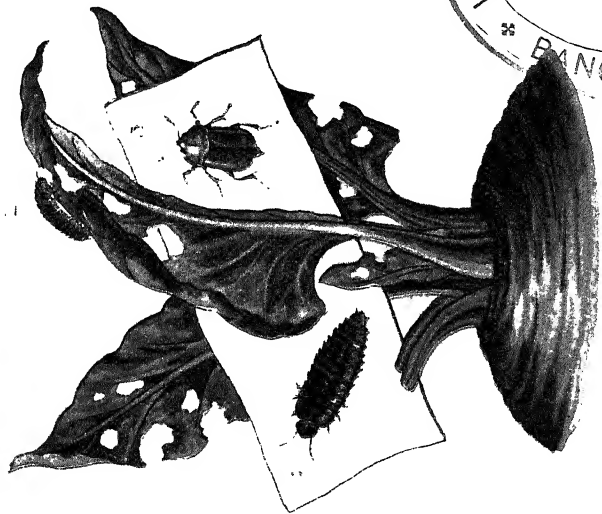


BEET CARRION BEETLE (*SILPHA OPACA*).

13 and 14. Larvæ feeding on a beet leaf; 15, Typical woodlouse-like larva; 16, Another view of larva; 23, Beetle; 24, Beetle with wings expanded.

Beet or Mangold Fly (*Pegomyia betæ*).—This is the parent of small yellowish-white or greenish maggots which feed on the pulp or inner tissues of the leaves of beet and mangold. The leaves, in consequence, shrivel, and the growth of the plant becomes severely checked. The fly lays its white eggs on the under sides of the leaves. In due course maggots are hatched, which eat through the epidermis, and devour the soft inner tissues. When fully grown the maggots escape, pupate in the soil or in the blisters of the leaves, and eventually develop into flies. Two or more broods appear in a year, and the flies often hibernate during the winter. See Coloured Plate.

REMEDIES.—The best remedy is a preventive one, namely, to encourage the plants to grow sufficiently vigorous to re-

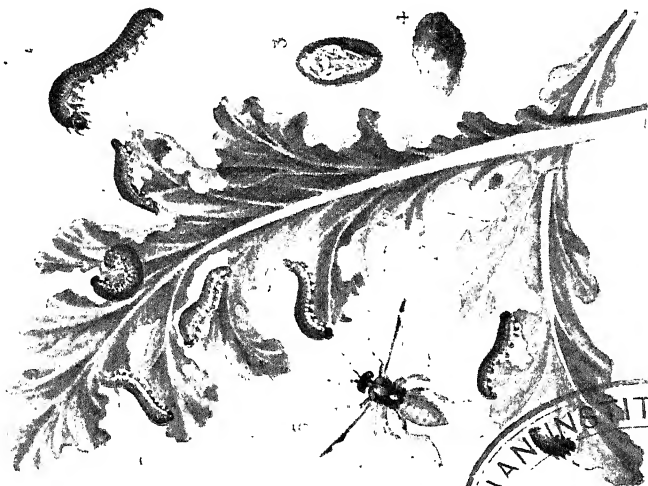


BEET CARRION BEETLE

(*SILPHA SP.*)

1.—Larva (enlarged). 2.—Larva at work (life size).
5.—The Beetle (life size).

(See p. 16.)



TURNIP SAWFLY

(*ATHALIA SPINARIUM*).

1.—Larva (enlarged). 2.—Larva at work (life size). 3.—Pupa or Chrysalis.
4.—Pupa (enlarged). 5.—Sawfly (enlarged). 6.—Eggs.

(See p. 97.)

A.C. 665



sist the attacks of the maggots. Keeping the soil well stirred disturbs the flies, and prevents them laying their eggs. A dressing of a soil fumigant before sowing will prevent a future attack of this pest.

Beet Rust (*Uromyces betæ*).—The foliage of beet is sometimes badly attacked by a rusty mould which seriously cripples the growth of the plants. The fungus first shows itself in the form of minute cups with whitish edges and congregated in clusters on the surface of the leaves. In due course these develop into a blackish-brown rust or mould.

REMEDIES.—When only a stray leaf here and there is attacked pick it off and burn it. When the crop is lifted, all infected leaves should be burnt, not left on the ground to rot or given to pigs, otherwise the fungus will reappear the next season. Beet should not be grown on the same plot again for several years.

Miscellaneous Pests.—Wireworms, Millepedes, Dart and Heart and Dart Moth Caterpillars and Leather Jacket grubs also attack the roots of beet. Consult contents for information concerning them.

BORECOLE (KALE).

See Cabbage Pests and Diseases.

BROCCOLI.

See Cabbage and Turnip Pests and Diseases.

BRUSSELS SPROUTS.

See Cabbage and Turnip Pests and Diseases.

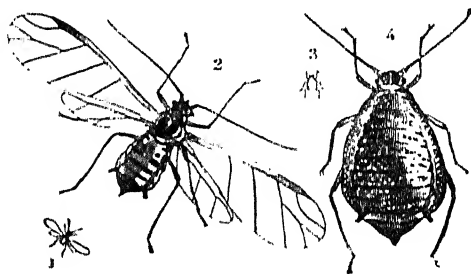
CABBAGE.

Black Rot of Cabbage (*Pseudomonas campestris*).—This disease has only recently made its appearance in England, but has been prevalent in America for some time. Its presence is indicated by the dwarfing or one-sided growth of the plants, and by the heads rotting off. Stems infected have a dark or brown ring in the centre, and the edges of the leaves turn brown. The disease is caused by a bac-

terial organism, and is supposed to find its way into the tissue through the medium of the water absorbed by root-hairs.

REMEDIES.—Burn every infected plant promptly, dress the vacant land with gas-lime, and do not grow any of the cabbage family on the same plot for a year or two.

Cabbage Aphis or Louse (*Aphis brassicæ*).—This pest is a relative of the Common Greenfly, and attacks the under sides of the folds of the leaves of cabbage, kale, Brussels sprouts, swedes—in fact, all members of the cabbage tribe. It injures the foliage by puncturing the epidermis, by sucking out the sap, and in due course causing it to become deformed and sickly. The aphides are the most prevalent in summer, and particularly so in dry seasons.



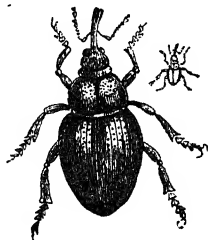
CABBAGE LOUSE (APHIS BRASSICÆ).

1 and 2, Male aphis (natural size and magnified). 3 and 4, Female aphis (natural size and magnified). Infests the leaves of the cabbage and its allies.

The lice commence to appear about May and the successive generations of females produce their young alive until autumn when oviparous females lay eggs which hatch out the following spring. The female aphides are of a yellowish-green and mealy-white colour. The young lice are densely covered with a mealy substance, and exude a sticky honey-dew like matter from their bodies which coats the surface of the leaves and render them filthy. Moreover, the result of an infestation is the puckering and yellowing of the leaves. In cases of bad attacks the hearts or sprouts are rendered unfit for use. See Coloured Plate.

REMEDIES.—Keep all cruciferous weeds such as charlock or Shepherd's Purse cleared away as the lice breed freely on these plants. In the case of an attack spray the plants repeatedly, until the insects are destroyed, with a solution of quassia, soft soap and water. Badly infested leaves should also be picked off and burnt.

Cabbage Gall Weevil (*Ceuthorhynchus sulcicollis*).—This is a small weevil averaging one-eighth of an inch in length and having a blackish-striped body. The weevil feeds on the soft parts of foliage. In summer it deposits its eggs just beneath, or on the surface of the skin of the roots of the turnip or the base of the stems of the cabbage. In due course white, legless, curved larvæ appear, and



CABBAGE GALL WEEVIL
(*CEUTHORHYNCHUS SULCI-
COLLIS*).

Weevil (natural size and magnified.)

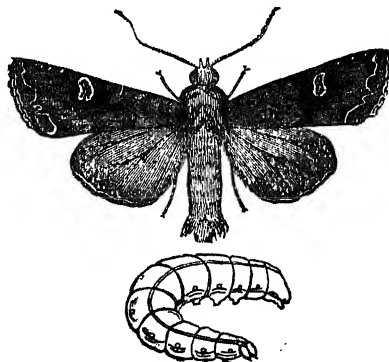
these at once commence to feed on the tissues and cause nodules or galls to form. Several broods are produced in a season. The larvæ become fully fed in fourteen to sixteen weeks then they quit the galls and pupate in the soil. The late broods exist as larvæ through the winter and pupate in spring. (See Coloured Plate.)

REMEDIES.—In the case of young turnips attacked cook the roots as soon as possible after paring off the galls and rind. Older or tough roots should be pulled up and immediately burnt, not fed to pigs, because of the probability of some of the larvæ pupating in the manure, and being afterwards conveyed to the land. The cabbages attacked become stunted in growth and turn yellow in the foliage. Such plants should be pulled up and burnt.

Badly-infested plots should be given a dressing of 28lb. of gas-lime to the square rod in autumn, letting it lie on

the surface until February, then digging it in. Or, the soil may be trenched 3ft. deep in autumn, and have, as the work proceeds a dressing of a good fumigant, such as a mixture of one part of naphthalene to fifteen parts of lime applied at the rate of 4 oz. per lineal yard of trench. It is also a wise plan not to grow crops, such as turnips or other members of the cabbage tribe, two years in succession on the same plot.

Cabbage Moth (*Mamestra brassicæ*).—The larvæ of this moth are most destructive in their habits; they feed not only on all kinds of garden plants, but more especially upon cabbages and cauliflowers. The moths are fairly large, have dark grey and black streaked forewings, brownish hindwings fringed with white, and brownish bodies. They appear from June onwards, flying only at night, and

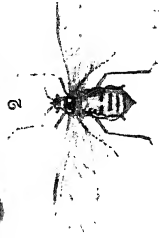
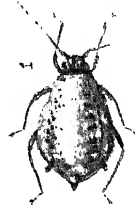


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CABBAGE MOTH (*MAMESTRA BRASSICÆ*).

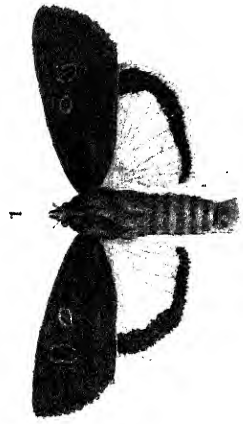
Moth and larva, natural size. Larva infests the "hearts" of cabbage and the "curds" of the cauliflower.

lay their eggs in groups on the leaves of the cabbage. In the course of a week greenish caterpillars appear, the colour subsequently varying from olive green to a reddish grey with a pale line down the back. They average $1\frac{1}{2}$ in. when fully grown, and if disturbed will roll themselves into a ring. In the case of cabbages and cauliflowers they gnaw their way into the hearts and render them filthy by



CABBAGE APHIS

(*APHIS BRASSICAE*)
 1.—Female Aphis (enlarged). 2.—Male Aphis (enlarged)
 3.—Damaged Cabbage. (See p. 18.)



GREAT YELLOW UNDERWING MOTH

(*TRYPXENA PRIONURA*)
 1.—Moth (natural size). 2.—Caterpillar. 3.—Chrysalis or pupa.
 4.—Eggs. (See p. 50.)

the deposition of a quantity of green excrementa. In other cases they eat holes in the leaves or feed on the soft parts. The larvæ are usually very prevalent in the autumn and some even may be found feeding in winter. Pupation takes place about a month or six weeks after hatching, and the shining chestnut-brown pupæ may be found in cells or naked in the soil in winter. (See Coloured Plate.)

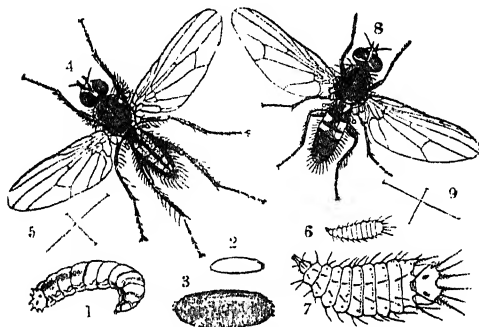
REMEDIES.—A sharp look-out should be kept for the pupæ when digging in the autumn, and any found should be fed to poultry or burnt. Directly caterpillars are seen collect and destroy them. Spraying does not kill all the larvæ, nor does dusting with lime or soot; besides these remedies spoil the cabbages, etc., for eating. When infested cabbages are cut for food immerse them for a time in a solution of salt and water.

Cabbage Powdered-wing Fly (*Aleyrodes brassicæ*).—This fly, which is related to the scales and aphides, attacks all the members of the cabbage family by congregating on the under sides of the leaves and sucking out the sap from the cells. Plants attacked turn yellow or brown in their foliage. The young insects are covered with small scales, and adhere firmly to the leaf. When they reach maturity they have white wings, and float in the air like tiny snow-flakes. The eggs are deposited in groups or circles on the under sides of the leaves and the larvæ hatch out in about a fortnight and at once pierce the epidermis and suck out the sap. Later on they pupate on the leaves and in a short time develop into flies. Myriads of these tiny flies are sometimes to be seen on the foliage, and if disturbed they dart away in fleecy clouds. They soon seriously cripple the foliage, hence should be promptly got rid of. Known also as Snowflies and Ghostflies.

REMEDIES.—Repeated spraying with a solution of soft soap, quassia and water is the only satisfactory way of getting rid of this pest.

Cabbage Root Fly (*Phorbia brassicæ*).—The larvæ of this fly, which is similar in appearance to the house-fly, attacks the lower part of the stems of cabbages and allied crops, eating their way into the tissues, causing the roots to de-

cay and the plant to die. Plants infested with the larvæ have leaves of a leaden hue that readily droop when the sun shines on them; also on the base of the stem and the roots are furnished with swollen lumps, within which are the maggots. The flies appear in May and onwards and lay their eggs on the stems just below the surface. In about a week yellowish-white legless maggots with wrinkled bodies tapering from the tail to the head, appear, and these at once gnaw their way into the main roots, also into the pith of the stem and devour the tissues. As a result hollows or cavities are formed in the roots and stems and the plants being unable to get a proper supply of food soon wilt and die. Several broods are produced and maggots may be found feeding all the year round. When fully



CABBAGE ROOT FLY (*PHORBIA BRASSICÆ*).

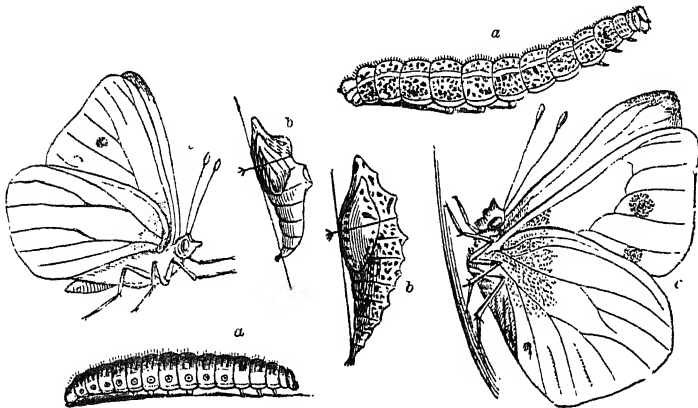
1. Larva (natural size). 2 and 3. Pupæ (natural size and magnified). 4. Fly (natural size). 5. Fly (magnified). 6 and 7. Larvæ (natural size and magnified). 8. Another species (*P. tuberosa*) which also occasionally attacks the roots of cabbage and the tubers of potatoes (natural size). 9. Fly (magnified).

grown the larvæ pupate in the cavities or in the adjoining soil. This pest must not be confounded with the Cabbage Gall Weevil Maggot. See Coloured Plate.

REMEDIES.—Dipping the roots and stems of the cabbage tribe in a thick mixture of soot, lime, clay and water before planting often prevents the flies laying their eggs on the stems. Another very excellent and effective method is to get some six-sided pieces of tarred cardboard 3in. in diameter, slit these through in one place to

the centre, where make several cuts to form a star. Each card is then placed around the stem by opening the slit, and the points of the star cuts pressed closed to the stem. This contrivance is said to be effectual in preventing the fly laying its eggs on the stem. A third method is to add half a pint of paraffin oil to a pail full of dry sand and place a thin layer of it around each stem at planting out time. A fourth method in case of attack is to dissolve a quart of soft soap in a gallon of boiling water, then add one pint of crude carbolic acid. Stir the whole thoroughly until properly mixed, then dilute with thirty equal parts of water and apply to the soil around each plant. Land that has borne infested crops should be dressed with a soil fumigant in autumn and not cropped with any of the cabbage family again for two or three years.

Cabbage White Butterflies (*Pieris brassicæ* and *rapæ*).—The caterpillars of these two butterflies prove very de-

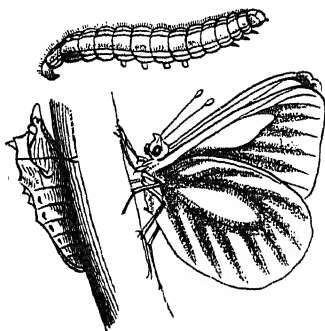


CABBAGE BUTTERFLIES.

Left-hand insect is the small Cabbage White Butterfly (*Pieris rapæ*) with its larva and pupa. The right-hand insect is the Large Cabbage White Butterfly (*Pieris brassicæ*) and its larva and pupa.

structive to cabbage and allied vegetables in some seasons. These butterflies are almost too well-known to need description since they are to be seen in every town, suburban or country garden. Suffice it to say the Large

White Butterfly (*P. brassicæ*) averages 3in. in the spread of its wings, and is mainly white marked or spotted with black. It appears from April onwards to October and lays its bright yellow, conical eggs in clusters on the under sides of the leaves. The larvæ appear in a few days. At first they are brownish-green spotted with black, but later change to a bluish-green with black spots or warts and a yellow line on their bodies. They remain in the larval stage for about a month and during that period devour the leaves freely. When fully fed they crawl away to the nearest fence, wall, etc., attach themselves thereto, and then pupate. Several broods appear during the season. The Small White Butterfly (*P. rapæ*) is smaller in size,



GREEN VEINED CABBAGE
BUTTERFLY (*PIERIS*
NAPI).

Butterfly larva and pupa,
natural size.

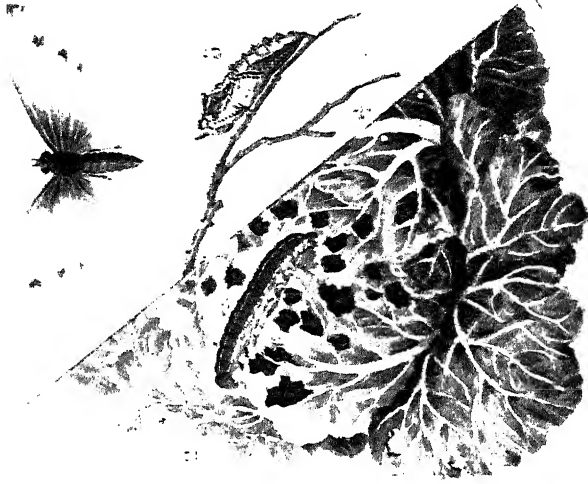
but similar in colour to the Large White. It lays its eggs singly on the under sides of the leaves. The larvæ are of a velvety green colour with a yellow stripe down the centre of its back and another on each side. When fully grown they are about an inch in length. Two or three broods are produced in a season. The Green-Veined White (*P. napi*) also attacks cabbage and turnips. The larvæ are of a velvety, pale green hue with orange spiracles. See Coloured Plate.

REMEDIES.—Hand-picking is the best method of getting rid of these pests. Sprinkling ground lime over the foliage will kill a good many, but, of course, not those deep in the hearts or under the leaves. A good drench-



CABBAGE BUTTERFLIES.
GREEN-VEINED WHITE BUTTERFLY
(PIERIS NAPI).

1.—Butterfly. 2.—Underside of wings. 3.—Chrysalis or Pupa.
4.—Egg. 5.—Larva. All natural size.
(See p. 21.)



SMALL WHITE BUTTERFLY

(PIERIS RAPAE).

1.—Female Butterfly. 2.—Larva. 3.—Chrysalis or Pupa.
4.—Egg. All natural size.
(See p. 22.)

ing with water through a hose will also get rid of them, as they cannot withstand water. Thunderstorms often clear a crop of the larvæ. Nothing, however, equals careful hand-picking as a sure remedy.

Cabbage White Rust (*Cystopus candidus*).—A fairly common fungoid disease on cabbages and other plants of the same order. It appears in the form of swollen, white patches, or irregular masses of snow-white powder. The effect of an attack is the distortion of the leaf and the ill-health of the plant. It is distinct from the Cabbage or Turnip Mildew (*Oidium balsamii*) which covers the surface with a white film of mycelium similar to hoar frost. Also attacks radishes, cress, water cress and turnips.

REMEDY.—There is only one, and that is pulling up and burning every infected plant, so as to stamp out the disease. Do not allow cruciferous weeds to grow in the locality.

Cockchafer Beetle (*Melolontha vulgaris*).—This is a native beetle belonging to the Lamellicornia family of the Beetle Order, Coleoptera, and popularly known as the May Bug, from the fact of the beetles appearing in warm



COCKCHAFER BEETLE (*MELOLONTA VULGARIS*).

Beetle is of natural size, but the larva is about half natural size.

evenings in May, and making a buzzing noise as they fly about over trees in search of food. The beetle itself does no harm to garden crops, but it is very destructive to the foliage of the oak, elm, and other forest trees. Its grub or larva is, however, a serious pest in gardens, since it lives deeply in the soil, and gnaws away the roots of cabbages, strawberries, and other crops.

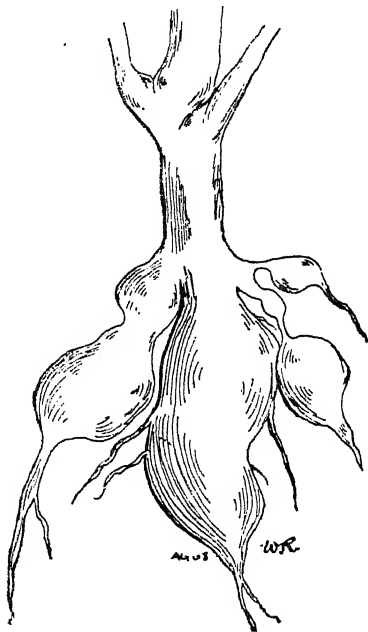
The female beetles appear in May and June, and burrow to a depth of 6 or 8 in. into the soil, and then deposit a cluster of about thirty to fifty whitish or yellowish round eggs. In due course, these hatch into fleshy, whitish grubs with a brown head. Each grub is furnished with three pairs of legs close to its head. The end of its body is swollen into a bladder-like sac, and its head is provided with very powerful jaws, by means of which it is able to bite through roots or gnaw off the rind of the roots of fruit trees and other crops. The body is curved. The grubs live in the soil for three years, and average, when fully grown, about 1 in. in length. During the autumn and winter they descend from 1 to 2 ft. deep in the soil, and come up to within a few inches of the surface in spring and summer to feed. At the end of the third year, they enter the pupal stage in an oval earthen cell, and appear as beetles the following May. See Coloured Plate.

REMEDIES.—Fortunately, these grubs have many feathered enemies, in the shape of rooks, starlings, plovers, and gulls, who diligently search for them in spring and summer, when they come nearer the surface. The mole also feeds on the grubs. As the grubs live so deeply in the soil, it is difficult to detect their presence, except when digging, and then a special point should be made of collecting and destroying all that can be found.

Silver Y Moth (*Plusia gamma*).—This is one of the night-flying moths, the larvæ of which feed on vegetable crops, such as cabbage, beans, beet, peas, etc. The forewings are of a glittering-grey colour, mottled with sepia brown, and the hind ones pale at the base, margined with a dark band. The head, thorax, and body are grey-brown. The female lays its eggs on the under sides of the leaves, and the larvæ hatch out in ten days. The caterpillars have glaucous green bodies, furnished with hairs, six white wavy lines down the back, and a yellow stripe down each side of the body. They reach maturity in a month, then enter the pupal stage in a whitish cocoon spun among the leaves. The pupa is black and shining. There are two to three broods in a year.

REMEDIES.—Hand-picking the larvæ and feeding these to fowls, which eagerly devour them, is the best remedy. Dustings of slaked lime or soot over the plants will render the foliage distasteful to the larvæ.

Club Root of Cabbage.—The disease which causes the roots of turnips, cabbages, and allied plants, also wall-



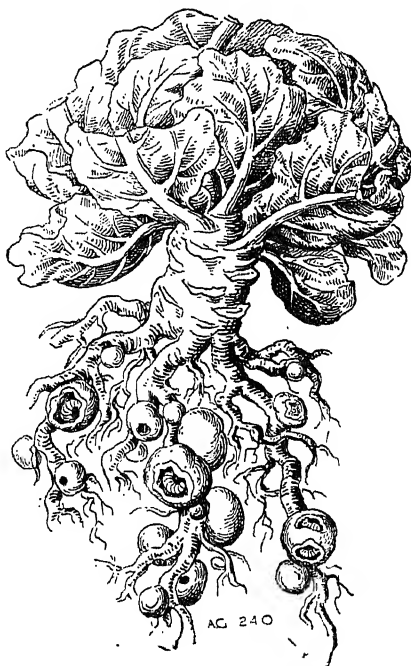
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CLUB-ROOT DISEASE (PLASMIDIOPHORA BRASSICÆ).

Badly diseased root of cabbage, showing malformations, considerably reduced.

flowers, to become distorted is commonly known as "Finger-and-Toe," "Club Root," and "Anbury." It is caused by a minute organism which finds its way into the cells of the roots, and then develops, fracturing the delicate tissues and causing them to become putrefied. The name of this organism is *Plasmodiophora Brassicæ*. It belongs to the Myomycetes or Slime Mould family. This

parasitical organism is reputed to perpetuate itself by means of swarm-spores liberated from spores present in the soil. They gain admission to the cellular system of the roots through the medium of the fine root-hairs. Therein the organism develops freely, considerably enlarging the root cells with its growth, and finally setting up the decomposition of the tissues into a rotten foetid



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CABBAGE GALL WEEVIL
(CEUTHORHYNCHUS
SULCICOLLIS).

condition. At this stage spores of the organism escape into the soil, remain quiescent until the land is cropped, then liberate swarm-spores to attack the roots. If the inside of a deformed turnip or cabbage root be cut open, the interior will be found to consist of a more or less black, slimy substance, offensive to the smell. This is the disease.

REMEDIES.—When the disease actually makes its appearance, which can be readily seen by the stunted wilting



CABBAGE WHITE BUTTERFLY

(PIERIS BRASSICAE)

1. Large White Butterfly. 2. Caterpillar or Larva fully grown. 3. Eggs. 4. Chrysalis or Pupa. (See p. 23.)



CABBAGE MOTH

(MAMESTRA BRASSICAE)

1. Caterpillar or Larva fully grown. 2. Moth. 3. Chrysalis or Pupa. 4. Eggs. 5 & 6. Young Caterpillars. (See p. 24.)

CARROT.

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character of the growth, the infected plants should be pulled up and burnt, not thrown on the rubbish heap or fed to pigs. The disease is often introduced to uninfected land by the agency of manure infected with the spores. The latter, moreover, are sometimes conveyed by the agency of the gardener's boots, tools, or a barrow. Soils that have been liberally treated with superphosphate or sulphate of ammonia have a tendency to become acid and sour, a condition highly favourable to the development of Club Root. The spores are reputed to retain their vegetative powers for three years at least in the upper five inch layer of the soil. Land that has borne a diseased crop should not be planted with any cruciferous crop for at least four years. The plot, as soon as cleared of the crop, should be given a dressing of fresh lime at the rate of 14 lbs. per square rod on light and 28 lbs. on heavy soils. Dig this in and thoroughly incorporate it with the soil. It is advisable also to use non-acid fertilisers, such as bone-meal, basic slag, and nitrate of soda as manures for the cabbage tribe. Club Root is never present in chalky soils, hence the great value of lime as a preventive remedy. A little lime and sulphur should also be forked into seed beds before sowing the seeds. It is a good plan when planting out permanently to place the roots of the seedlings 5 in. deep, and a month or so later to mould up the stems to a height of 6 in. This will encourage roots to form higher up the stems which will be immune from attack.

CARROT.

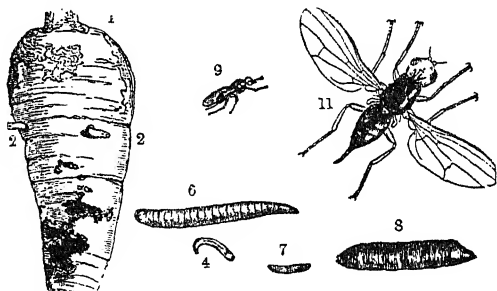
Carrot Fly (*Psila rosæ*).—The maggot or grub of this fly, which belongs to the same family as the house fly, is responsible for the formation of the rusty patches on the roots of carrots. The greenish-black flies, which are small, lay their eggs on the roots of the carrots during late spring and summer. When hatched the maggots at once bore into the soft parts of the roots, form cavities, and generally disfigure the roots. The maggots are transparent, yellowish-white, shiny, legless, and a quarter of an inch long. The insects remain in the larval stage for a month then change into pupæ in the soil. Several broods are produced in a season, the last one remaining in the pupal stage till April or May, then appearing as flies.

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Carrots attacked by this pest have pale foliage and a stunted growth. See Coloured Plate.

REMEDIES.—Birds are partial to the pupæ or chrysalides present in the soil in autumn and winter, and no doubt they destroy large numbers of them. But it is not wise to rely upon the help of birds alone. All roots that are attacked by the maggot may be easily identified by the wilting and shrivelling of the leaves. Such plants should be pulled up, placed in a pail, and afterwards burnt to destroy



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CARROT FLY (PSILA ROSÆ).

1 and 2. Root infested with grubs. 6. Grub, magnified. 4. Grub, natural size. 7 and 8. Pupæ, natural size and magnified. 9 and 11. Fly, natural size and magnified.

the larvæ attached to them. In autumn the plot, in which the infested crop was grown should be deeply dug, and have a fumigant, such as one part of naphthalene to fifteen parts of ground lime, well mixed with the soil as the digging proceeds. The upper three inches of surface soil should be thrown into the bottom of the trench so as to bury the pupæ. Ridging infested soils in autumn is also good, as this exposes the pupæ to birds, and also to the destructive action of frost.

So far as preventive measures are concerned, there are many. One of the best, perhaps, is to scatter sand or fine cinder ashes, saturated with paraffin oil, over the surface of the soil. Use a quart of oil to a barrow-load of sand or ash. If wood ashes are available, use this in preference to cinder ashes, as they will supply potash to the crop. The smell from the oil seems to prevent them depositing

their eggs. A barrow-load of above will suffice for a square rod of ground.

The flies generally choose the period for laying their eggs directly after the crop has been thinned, this operation loosening the soil and enabling the flies to descend to the roots. So, as thinning proceeds, see that the soil is made firm around the remaining seedlings. After thinning, too, water the soil with paraffin oil and water, adding one gill of the former to a gallon of the latter. Another remedy is to water the soil with alum and water, one ounce to a gallon, if the foliage shows signs of withering.

Carrot Disease (*Phoma sanguinolenta*).—A fungoid disease which attacks both the stem and the root of the carrot, causing sunken canker-like spots to form on the latter. Wherever the stems are to be seen coated with a minute mould, or the roots detected with sunken greyish-brown spots, it may be safely assumed that the disease is present.

REMEDIES.—Pull up and burn any plants showing the presence of disease on the foliage, and when lifting the crop pick out and burn all cankered roots.

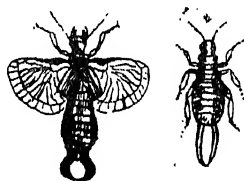
Other Pests.—Leather Jacket Grub, Wireworms, and Yellow Underwing Moth.

CAULIFLOWER.

Earwig (*Forficula auricularia*).—This insect belongs to the family Forficularidæ of the order Dermaptera, and is closely allied to the cockroach, cricket, and grasshopper. The mature insect is about half an inch in length, the male being furnished with curved anal forceps or pincers, and the female with shorter and straighter ones. Earwigs have a pair of ample, delicately-formed wings, which are fan-like when expanded, and elaborately folded and doubled up when not in use under short wing cases. The folding is assisted by the aid of the forceps. The wings, however, are very seldom made use of, and then only after dusk or on moonlight nights. The female lays her eggs in spring or early summer in clusters of fifteen to twenty under dead leaves, decayed rubbish,

stones, or in the crevices of the bark of trees. She broods over the eggs similar to a bird for about a month, when the larvæ are hatched. The female continues to look after her progeny with maternal care and solicitude, and it has been noted that the larvæ cluster under her body for warmth and protection just as chickens do under a hen. The larvæ are paler in colour than the parents, have no wings or wing cases, and only weak and straight forceps or pincers. They change their skins several times as they increase in size, and eventually develop into perfect insects.

Earwigs are nocturnal in their habits, hiding during the day under rubbish, in flowers, or in crevices of walls, etc. At night they crawl into the blooms of such double-flowered plants as dahlias, chrysanthemums, carnations, etc., and feed on the tender petals, nibbling holes in them,



EARWIG (FORFICULA
AURICULARIA).

Female with wings expanded
and its larva.

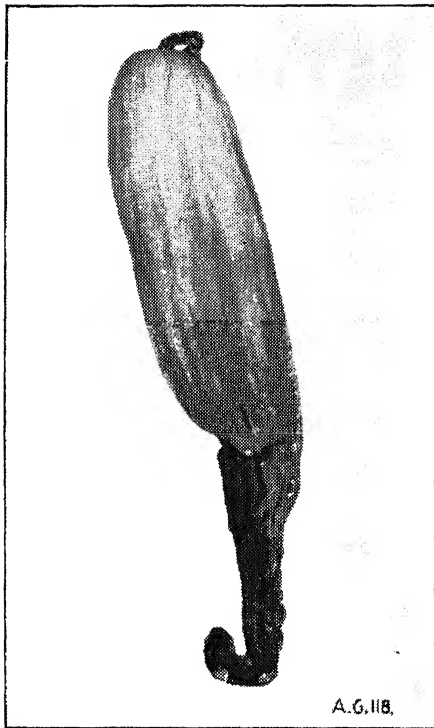
also on the stamens and pistils. They also attack ripe fruits of peaches, nectarines, apricots, apples, pears, and grapes, and often do serious injury to them. Cauliflowers are often badly infested with earwigs. Blooms of pansies and violas are frequently spoiled by earwigs nibbling holes in the petals. Young shoots of many plants are also liable to attack by them. In cases where they gain access to dwelling-houses they have been found feeding on bread and meat. On the other hand, some naturalists affirm that earwigs possess a carnivorous habit and attack aphides and thrips. They, however, do far more harm than good, and, therefore, should be exterminated wherever possible. See Coloured Plate.

REMEDIES.—The earwig has many natural enemies, among which may be specially mentioned birds, toads, Devil's coach-horse beetle, ichneumon flies, etc. But, although these may account for the destruction of many



CUCUMBER ROOT BEELWORM.

This pest attacks the roots of the cucumber, and often ruins a whole crop of plants. (See Cucumber Pests, page 38.)



A.G. 118.

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CUCUMBER FRUIT ROT DISEASE.
(See Cucumber Pests, page 37.)

hundreds of earwigs and their larvæ, far too many exist for waging war on plants and crops, and so other remedies must be employed to keep them in subjection. One of the best means is to take advantage of their natural habit of seeking shelter during daylight. This can be accomplished in various ways. One is to half-fill dirty flower pots with dry moss, grass, or hay, and invert these on stakes near the plants. Each morning dip the pot and its contents for a moment in hot water, or shake the



A SIMPLE EARWIG TRAP.

A partly open match-box suspended by a piece of wire to the shoot of a plant.

contents over a path to dislodge the earwigs and crush any that fall out under foot, then replace the pots on the stakes. Or twist a piece of paper into a cone, and place it on the top of a stake, opening it out each morning and crushing under foot any earwigs that drop out.

Other remedies are to place short pieces (1 ft. long) of hollow sunflower or broad bean stems among the plants. The earwigs will crawl into these. In the morning place one end to the mouth and blow out the hiding earwigs into a vessel of hot water. Pieces of bamboo cane will

answer the same purpose. Elder shoots with their pith pushed out and corked at one end also make good traps. So also does an empty match-box, partly opened, and suspended by a piece of wire to a stake. Similar traps should be placed about rooms infested, and examined every morning. Pieces of crumpled paper placed about forms a good hiding place for earwigs.

Since adult earwigs hibernate during the winter under dead leaves and rubbish, such debris should be collected and burnt. Earwigs generally abound in gardens containing heaps of rubbish. Dead stalks from stored dahlia roots should be removed and burnt, as these harbour earwigs. Pot plants are sometimes stood in saucers of water under the impression that earwigs cannot reach the plants. While this is true, so far as the larvæ are concerned, it is not so as regards the adults, as it is possible for them to fly at night from one plant to another.

Other Pests.—Cabbage Aphis, Cabbage Gall Weevil, Cabbage Moth, Cabbage Butterflies, Cabbage Root Fly Maggot. See also Cabbage.

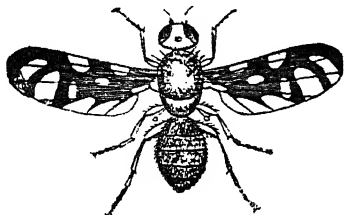
CELERY.

Celery-Leaf Blight (*Septoria apii*).—A fungoid disease which attacks the foliage of celery in wet seasons and causes pale spots to form thereon. The infected leaves eventually turn to a greenish-brown colour and either wither or become rotten.

REMEDIES.—Diseased plants should be promptly burnt, and on no account allowed to rot on the ground or be thrown on the rubbish heap. Nor should celery be grown on the same site again for several years. The disease is sometimes conveyed to the plants by means of infected seeds, so great care should be taken to obtain clean ones from a reliable source.

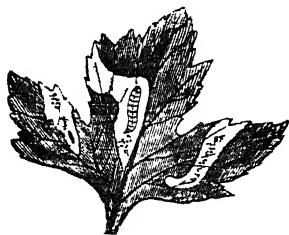
Celery Leaf Mining Fly (*Acidia heraclei*).—This insect attacks the leaves of parsnips, celery, and parsley. The fly is about one-sixth of an inch long, of a brown colour, with two transparent wings and green eyes. The female appears from April onwards and deposits her eggs singly on the upper side of the leaves, where they are hatched,

producing small, legless, white to green larvæ, which cause large blisters to form upon the leaves. These larvæ, or maggots, cause complete or rapid decay of the foliage. Pupation takes place about a fortnight after hatching. The brown pupæ of this fly are found on the leaves of the host plant and in the earth; as a rule, the maggots leave



CELERY FLY (*ACIDIA*
HERACLEI).

Fly, magnified and natural size.
Larvæ tunnelling in the tissues
of a leaf.

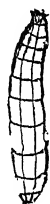
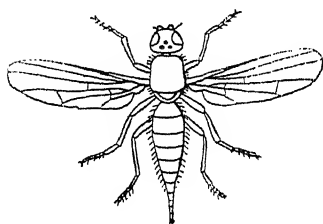


the host plant and turn to pupæ in the soil. There are several broods during the year, but the pupæ last produced hibernate in the soil until the following spring, when they appear as perfect insects and renew the attack. See Coloured Plate.

REMEDIES.—Owing to the maggots feeding within the leaves, it is difficult to apply any insecticide that will reach them without at the same time destroying the foliage. Picking off the portion of leaf infested, and burning the collected portions, is the only remedy once the maggots are in the leaves. The flies may, however, be prevented depositing their eggs by spraying the foliage occasionally with the following preparation: Mix half a gallon of tar with a gallon of water, and place this on a fire till it boils.

When cool add fifty gallons of water, and then spray the foliage thoroughly with it. Another good plan is to pour as much paraffin oil on a piece of brick as it will absorb, then steep this for a day or two in three gallons of water. Another remedy is to dissolve $\frac{1}{2}$ lb. of soft soap in a gallon of boiling water, then add one pint of crude carbolic acid and thoroughly mix, afterwards adding more water to make ten gallons of solution. Spray the foliage with this. Spraying should be done during May, June, and July. Before preparing the trenches dress the ground with a soil fumigant to destroy the pupæ and prevent them developing into flies.

Celery-Stem Fly (*Prophila apii*).—The fly is somewhat similar in size and form to the Celery Fly, which see. It



CELERY STEM FLY
(*PROPHILA APII*).

Fly and larvæ greatly magnified.

has a black, shiny, body clothed with golden hairs. The maggot is yellowish-white. The latter bores into the root stock of the celery, and thence upwards in the leaf stalks, causing rusty-brown patches to form. Its life history does not seem to be fully known yet.

REMEDY.—There is only one, and that is to burn all infested plants, and dress the soil with one of the soil fumigants to kill the pupæ.

Celery Blight or Rust (*Septoria Petrosellini*).—A fungal disease which attacks the leaves of celery and parsley, especially in the autumn, causing irregular brown, rusty spots to develop. In bad attacks the disease spreads over the entire surface of the leaves, and destroys them.

REMEDIES.—Collect and burn at once any leaves infected with brown spots, and in the case of those not



AG 607

CELERY LEAF-MINING FLY

(ACTIA INTRACTA).
1.—Fly. 2.—Leaf damaged by the Larva. 3. Chrysalis or Pupa.
4.—Maggot or Larva. (See p. 31.)

BEE T FLY

(PEGOMIA BETE).
1. Fly. 2.—Injured Leaf. 3.—Eggs. 4.—Maggot or Larva.
5.—Chrysalis or Pupa. (See p. 36.)

attacked spray the foliage at once with a solution of sulphide of potassium and water. See formula at the end of this work.

CUCUMBER AND MELON.

Cucumber Fruit Rot (*Colletotrichium lagenarium*).—A fungus disease which attacks the ends of the fruits of cucumbers, melons, and marrows, causing them to become soft and rotten. The leaves and stems are also liable to be attacked. This disease is more prevalent on cucumbers grown in greenhouses and frames.

REMEDIES.—No satisfactory remedy has yet been found for this disease. It seems to attack plants that are grown in too low a temperature and where the roots get chilled by the too frequent application of cold water. To guard against infection a brisk warm temperature should be maintained and tepid water only used for watering or syringing. All infected fruits should be promptly removed and burnt.

Cucumber-Leaf Spot (*Cercospora melonis*).—This disease occasionally attacks the foliage of the cucumber and melon. The first symptom is the appearance of pale green spots scattered about on the surface of the leaves. These spots gradually spread until they run together, and at the same time pass through a grey to a brownish colour. This is the fruiting stage of the fungus. If it be examined at this time with a lens it is found to consist of a lot of fine, upright, brown threads, each bearing a fruit or "conidium" at its tip. These conidia are the reproductive bodies, and can be carried from diseased to healthy plants on currents of air, clothing, or insects. Sometimes the leaves dry up and fall to the ground, when the mycelium present in the tissues quickly grows, forming cob-like threads, which run on the surface of the soil, producing more conidia. Failing food, the disease passes into a resting state, in which form it may remain inactive in the soil from season to season, only to spring into life again on the advent of warmth and moisture. These latter conditions are absolutely necessary to the pest, and so it can only attack plants under glass, attempts to in-

oculate plants grown outside having failed. There is said to be no risk of infection from the seeds.

REMEDIES.—The foliage should be kept as hardy as possible by the admittance of plenty of air, and the atmosphere should not be kept any moister than is absolutely necessary. Spraying in anticipation, with a solution of two ounces of potassium sulphide in three gallons of water, adding two ounces of soft soap, is recommended. The under sides of the leaves should be carefully sprayed and the soil well drenched with the solution if the disease is present. Diseased leaves should be removed and burnt.

Eelworms.—Cucumbers and tomatoes as well as many other crops are liable to be attacked by microscopic worms commonly known as eelworms. The most destructive kind is the Root Knot Eelworm (*Heterodera radiculicola*). The worms are too minute to be seen by the naked eye. They have translucent bodies and are generally present in large numbers in leaf mould, decayed manure, and rotten debris. In this media they are conveyed to the soil and from thence find their way into the tender root-hairs of the plants. The worm by means of a spear-like organ easily penetrates the outer epidermis, enters, and embeds itself in the tissues, thus causing galls to form on the roots. Here the females deposit eggs freely which hatch into minute young worms that, of course, form new or increase the size of the existing galls. In the course of time the galls and the consequent disorganisation of the tissues render the plants sickly and kills them. The galls vary in size from that of a cabbage seed to that of an ordinary marble. An example of an infested root of a tomato is shown in an illustration in this work.

REMEDIES.—Since the worms are in the tissues it is impossible to get rid of them except by burning the plants and its roots. The only effectual remedy is to sterilise the compost before planting. This can be done by mixing one part of carbolic acid with twenty parts of water and thoroughly sprinkling the soil three times at intervals of a fortnight before taking it indoors. See also chapter on "Sterilisation of Soils." Part II.



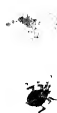
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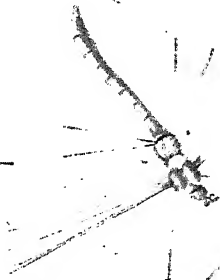


3



4

Actual size
across wings
 $2 \frac{5}{8}$



1



2



3



$1 \frac{3}{8}$

4

AG. 593.

TURNIP GALL WEEVIL

(*CEDRORHINUS SULCICOLLIS*).

- 1.—Galls, the result of injury by the maggots.
- 2.—Parent Weevil (magnified).
- 3.—Maggot or Larva (slightly magnified).
- 4.—Eggs deposited in surface of skin.

(See p. 19.)

DADDY LONG LEGS FLY

(*TIPIULA OLERACEA*).

- 1.—Fly (natural size).
- 2.—Chrysalis or Pupa.
- 3.—Maggot or Larva ("Leather-jacket").
- 4.—Eggs laid on the base of a plant of the Quaking Grass (*Briza media*).

(See p. 19.)

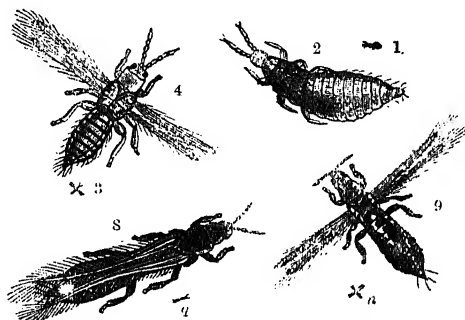
Red Spider (*Tetranychus telarius*).—The Red Spider so prevalent in greenhouses and hothouses is a very small mite, averaging about 1-50in. in length, which spins a fine delicate silken web over the under surface of the leaves. Under the protection of this the adult mites deposit their nearly colourless eggs, which in due course produce six-legged youngsters. These at once start to pierce the epidermis and to suck out the sap, the result being a scorched appearance of the leaves. This pest multiplies freely in a hot, dry atmosphere, and if not immediately eradicated, will soon ruin the foliage or other plants attacked.

REMEDIES.—The best safeguard against an attack of Red Spider is to maintain a moist atmosphere, since moisture is fatal to mites. The foliage, surface of the beds, paths, and walls should therefore be well syringed morning and afternoon to maintain a humid atmosphere. In the case of an attack an application of flowers of sulphur applied freely to the leaves by means of a sulphur bellows, or painting the hot water pipes with a mixture of flowers of sulphur and skim milk, are the best remedies.

Thrips (*Heliothrips hæmorrhoidalis*).—These are minute four-winged insects, measuring about 1-16in. in length, with black bodies, banded with white, and finely fringed wings. They are wonderfully agile in their movements, disappearing directly the leaves are touched. The females lay their microscopic eggs on the under sides of the leaves of cucumbers and other plants. These hatch into wingless, yellowish larvæ about 1-20in. long in ten days, and then proceed to spread themselves about the leaves, pierce the cuticle by means of their proboscis, and suck out the sap. In due course, brownish patches or blotches appear as the result of the injury, and the surface of the leaf becomes covered with a glutinous excreta which seals up the stomata or breathing spores and prevents the leaves carrying out their proper functions.

REMEDIES.—When numerous, thrips do an immense amount of injury to the foliage and flowers, therefore, directly their presence is discovered, steps should be promptly taken to eradicate them. The most satisfac-

tory method is by fumigation with nicotine. One application, however, will not suffice; it will only kill the adult insects, and not affect the eggs. The fumigation must, therefore, be repeated once a week until all the successive



THRIPS OR THUNDER FLIES.

Active minute insects which congregate on the leaves of plants and suck out the sap. The illustration portrays two species, natural size and magnified.

broods of adults and larvæ are destroyed. Where fumigation cannot always be carried out, spraying the plant or sponging the infested leaves with a solution of a good insecticide may be adopted with success.

ENDIVE.

See Lettuce Pests and Diseases.

GARLIC.

See Onion Pests and Diseases.

KOHL-RABI.

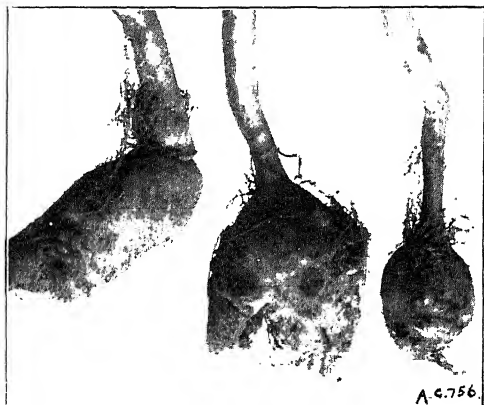
See Cabbage and Turnip Pests and Diseases.

LEEK.

See Onion Pests and Diseases.

LETTUCE.

Leather-Jacket Grubs (*Tipula oleracea*, *paludosa*, etc.)
—These are the larvæ of Craneflies, popularly known as Daddy-long-legs. The flies of *T. oleracea* have a distinctive appearance, being furnished with long, ungainly



A.G.756.

CABBAGE ROOT GALL.

The maggots of a weevil (*Ceuthorhynchus sulcicollis*) punctures the roots of turnips and cabbages, and causes them to become swollen as shown. (See Cabbage Pests, page 19.)



A.G.755

ROOT OF TURNIP INFESTED WITH CABBAGE GALL GRUBS.

The root has been deformed by the larvae of the Cabbage Root Gall Weevil feeding within. (See Cabbage Pests, page 19.)

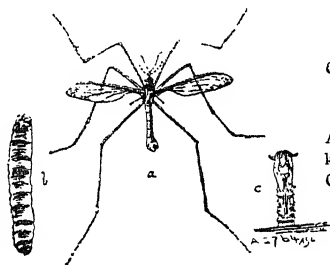


A.G. 284.

ONION DISEASE.

Bulbs infected with a fungus disease called *Sclerotinia bulborum* (See Onion Pests, page 56.)

legs, which enables them to easily skip about in an awkward fashion over pastures and lawns in the evening during summer, but more especially in August. Their bodies are of a greyish colour, while their wings are of a brownish tint. A second species, *Tipula paludosa*, appears late in summer, and is of a reddish-brown colour. So far as their life history is concerned, all the crane-flies are alike in their general habits. They deposit their eggs, to the number of 300 each, at the base of the stems



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DADDY LONG-LEGS FLY
(*TIPULA OLERACEA*).

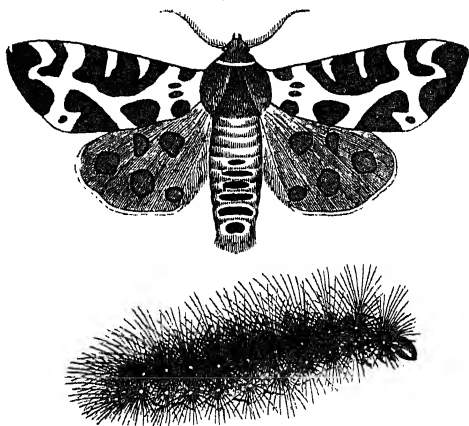
A. Is the fly. B. Its larva, familiarly known as the Leather-jacket Grub. C. Larva in the pupal or chrysalid stage.

of grasses. The eggs are usually laid in late summer or early autumn, are elliptical in shape, small, and of a shining black colour. These are supposed to hatch in about fifteen days.

The larvæ or grubs are about an inch long when fully grown, absolutely devoid of legs, cylindrical in shape, and of a dirty yellowish-brown or brownish-grey colour, with one or two faint lines down their back. They have a black head furnished with powerful jaws, which enables them to easily bite through the stems of young cabbage, lettuce, etc. Their tail is blunt or truncated, and underneath they are provided with tubercles, which serve the purpose of a foot. The grubs are slow in their movements. When fully grown—usually in about a year or less—the grubs enter the pupal or chrysalid state just beneath the surface of the soil. While in this stage of its life cycle, the pupa develops a row of spines on each segment of its pupal case, and when the time has arrived in summer for it to appear as a fly, it gradually pushes its way, by the aid of the spines, up through the grass or soil, and emerges as the perfect insect. We may add

here that the skin of the grubs is very tough and leathery, hence the popular name of "Leather-jacket." It is said that frost has little effect on the vitality of these grubs, and that, even when frozen hard, they have been noted, after their bodies have thawed, to again resume their activity.

Leather-jacket grubs are very voracious. During the winter they retire deeply into the soil, but on the approach of warm weather they come nearer the surface, feeding on the roots of newly-planted seedlings of the cabbage tribe, lettuce, and other vegetable crops. Hence, whenever a plant is found with a stem bitten through, a search for the culprit should be made. They also attack the stems of violas, dahlias, carnations, and other garden



TIGER MOTH (*ARCTIA CAJA*) AND LARVA.

The caterpillar is known as the "Woolly Bear." Both natural size.

flowers. In some seasons they are particularly destructive to the roots of grasses on lawns, causing the herbage to turn yellow and die in patches. Turnips, swedes, carrots, and even potato tubers, are not exempt from attack by the grubs. Strawberry plants, too, are often attacked; in fact, when they are very numerous they are capable of attacking the roots of vegetation generally. They feed beneath the surface by day, and come to the top at night.

The grubs of the Spotted Crane Fly (*Pachyrhina maculosa*) have been discovered attacking tulip bulbs in a wholesale manner, as well as the roots and flower buds of strawberries, carrots, etc. The grubs in this case average $\frac{3}{4}$ in. in length, are of an earthy colour, and much wrinkled. Their life history is similar to the Daddy-long-legs Fly and its larvæ. See Coloured Plate.

REMEDIES.—These pests are very difficult to cope with on account of their tenacity of life. Where not very numerous the grubs may be readily trapped by placing pieces of board, slate, or tile, on the surface of the ground in the evening. Early the next morning they will be found congregated by the dozen or score just underneath, the exclusion of light and sun tempting them to remain above rather than below the surface of the soil. Collect and burn the pests. This remedy should be practised where they are suspected to be present in lawns. Another method of trapping is to bury pieces of cut potato, carrot, or turnip attached to a skewer just beneath the soil. Examine these every morning, and collect and destroy any grubs attached. Digging in a soil fumigant in autumn would destroy the younger grubs. Gas-lime does not seem to be of much use. Allow no rubbish or coarse grass to exist in a garden, because both form tempting breeding grounds. Induce children to catch as many of the flies as possible when they are on the wing in the evening. Every fly killed means 300 less grubs another year. Leather-jackets are liable to be present in large numbers in grass land, so, when breaking up such ground, bury the turf deeply and sprinkle it freely with salt and lime, or a fumigant, to destroy any pupæ or larvæ present. Frequent hoeing of the soil in the evening, when the grubs are near the surface, is also a good practice, as, if the hoe used is sharp, it will injure, if not kill, many of the grubs, besides exposing so that birds can devour them.

Tiger Moth (*Arctia caja*).—The hairy larvæ of this beautiful moth, popularly called "Woolly Bears," feed on lettuce and many other garden crops. They are easily distinguished by their blackish bodies, which are covered

with long, whitish, silky hairs on their backs and rusty-coloured ones on their sides. The moths appear in July, and are 2 to 3 in. in width across their expanded wings. The forewings are brown and creamy-white, and the hind ones are red, orange, and purple; the bodies are red, barred with black. The young larvæ hibernate during the winter, pupate in June, and appear as moths in July.

REMEDIES.—Hand-picking is the best remedy.

Lettuce Downy Mildew (*Bremia lactucae*).—A minute fungus which covers the under surface of the leaves of lettuce, chicory, and wild composite plants, generally with a fine white mould. In course of time the infected leaves turn yellow and die.

REMEDIES.—The safest remedy is to pull up and burn every plant infected. It would not be safe to spray the plants with fungicides, on account of the poisonous properties of the latter.

Lettuce Root Aphis (*Pemphigus lactucarius*).—A genus of Aphides or plant lice which infest the roots of lettuce, grasses, and many other plants. Large lettuce plants sometimes droop and look sickly. On pulling up the plant the roots will be found infested with insects, having their bodies clothed with fine cottony down. They live in colonies in cavities lined with the fine cottony filaments exuded from their bodies. These are the Lettuce Root Aphides. They cluster round the base of the stem and on the roots, and suck out the sap from the cells.

REMEDIES.—When plants turn yellow and droop lift them, and if insects are present place the plants in a pail of soapy water, then destroy them. In the holes occupied by the roots pour plenty of soapy water containing a little paraffin oil, afterwards digging in fresh lime.

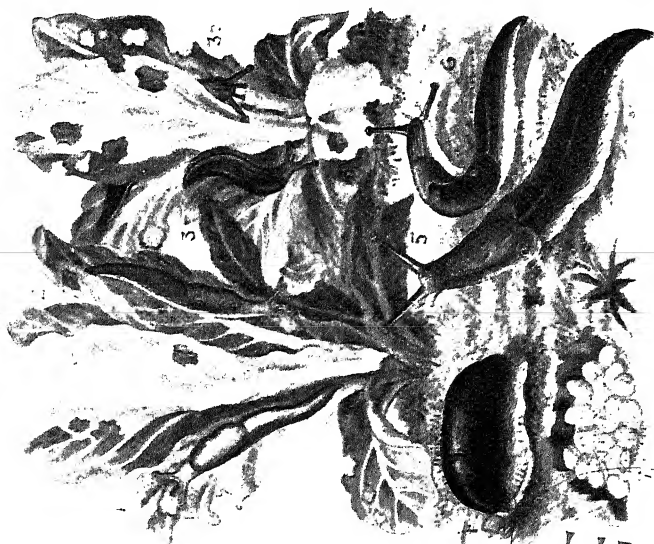
Snails (*Helix aspera*).—The snail has a highly-developed muscular body, the under part of which is flat and soft, and answers the purpose of a foot for enabling it to travel along the ground. It is a very sensitive animal, and instantly withdraws its head into its shell on the ap-



COMMON GARDEN SNAIL

(*HELIX ASPERSA*)

1. Snail of natural size.
2. Young snail feeding on a leaf.
3. Eggs. (See p. 11.)



COMMON GARDEN SLUGS

1. The Milky Slug (*Veronica* agri-(65).
2. Young Grey Slug (*Arion hortensis*).
3. Young Black Slugs (*Arion ater*).
4. Grey Slug at rest.
5. Red Slug (*Limax ruber*).
6. Grey Slug crawling.
7. Cluster of Eggs. (See p. 11.)

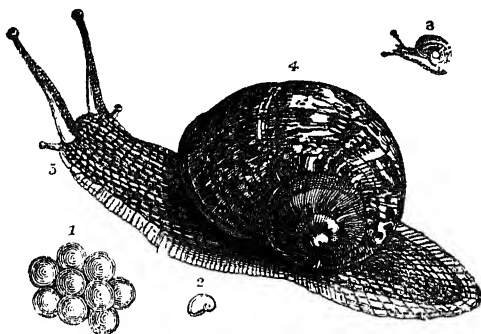
A.E.G.31

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proach of danger, hence the origin of the country children's taunt to a snail in its shell:

"Snail, snail, come out of your hole,
Else we shall beat you as black as coal."

It is chiefly nocturnal in its habits, becoming active in the evenings during spring and summer, retiring to its shell on the approach of daylight. In warm showery weather, however, it resumes its activity during the day. During periods of drought the snail cannot easily move about, and hence prefers to remain in a torpid condition within its shell. Snails always feed on or above the surface of the ground, and never below, as slugs often do. They are very destructive creatures, and do serious injury



GARDEN SNAIL (*HELIX HORTENSIS*).

1, Eggs, natural size. 2. Newly-hatched snail. 3. Young snail. 4. Adult snail.

to the succulent shoots and leaves of plants, as well as crops. During the day they hide under rubbish, underneath the foliage of ivies, or among dense-growing plants on rockeries. They also attach themselves in winter by their "collar" and mucus formed at the orifice of their shells to garden fences or walls, or one to another in colonies in the crevices of rockwork, or in shady or dark positions; also congregate under heaps of garden rubbish, etc.

Snails are hemaphrodite animals, each furnished with male and female organs, but it is said they are incapable

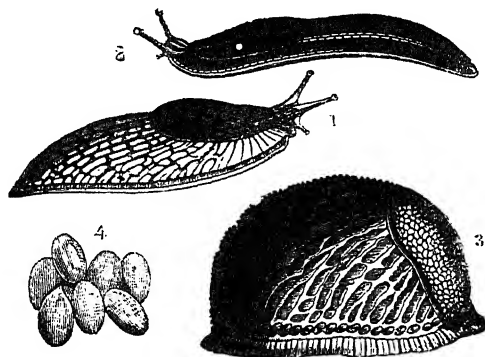
of self-fecundation. The eggs are round, white, and shining and are deposited in colonies of 60 to 70 an inch or so below the surface of the soil during the summer months. Generally speaking, the eggs hatch in fifteen to twenty-one days, but some may not do so until the following spring. They are reputed to possess great vitality and to be unaffected by frost. Directly the youngsters are born, they at once commence to feed on the tender leafage of plants, and soon do an immense amount of damage in a single night. Usually they are too timid and shy to appear in the day-time, preferring the evening.

Snails are furnished with a somewhat rasp-like mouth, armed with small teeth, which enables them to easily bite and masticate the soft parts of leaves or fruits. It may be interesting to add here that the snail is blind, deaf, and dumb. It is true a snail when disturbed often emits a slight sound, which is caused by displacing the air as it withdraws its body into the shell. The so-called "horns" of a snail or slug are known as tentacles, organs, which, like the whiskers of a cat or mouse, warn the snail of anything coming in its way. They are really highly sensitive organs of touch. The snail has a heart, lungs, a rudimentary brain, and pale rose-coloured blood. See Coloured Plate.

REMEDIES.—See under Slugs.

Slugs.—Garden slugs may at once be readily distinguished from snails by their having no shells on their bodies. They vary greatly in size. Altogether there are about fifty species, but fortunately only a few prove a really serious source of worry to the gardener. In place of the shell common to the snails, slugs have a kind of raised shield or mantle on their backs, under which, when disturbed, they usually withdraw their heads for protection. The outer skin is more or less furrowed, and covered with a slimy substance, and the front portion of their heads is furnished with two pairs of "horns" or tentacles—two short, and two long ones—which serve a similar purpose to those of the snails. Their internal organs are alike to those of snails. Some naturalists are of opinion that they possess an imperfect vision, but have no sense of hearing, and they are, of course, quite dumb.

The kinds most harmful to garden crops are the Black Slug (*Arion ater*); the Field, Milky, or Grey Slug (*Agriolimax* or *Limax agrestis*); Red Slug (*Limax rufus*); and the Striped Slug (*Limax maximus*). The first-named species is fairly common, and varies in colour from black to red, yellowish-white, and brown, and is usually covered with a yellowish slime. The second species is of an ash-grey colour, tinged with red or yellow, and covered with a milky slime. This is



GARDEN SLUGS.

1. Milky Slug (*Limax agrestis*). 2. Black Slug (*Arion ater*) in young stage.
3. Adult variety of last-named species in repose. 4. Eggs.

the most destructive of all the garden slugs. The third species is of a reddish colour, and not so common. The fourth species is a large kind, averaging when fully extended, about four to six inches in length.

But whatever the species may be, they are hermaphrodites, as in the case of snails, and reproduce themselves by means of eggs which are oval or round in shape, opaque, and white in colour. The eggs are deposited in the soil, under garden rubbish, or in moss between May and September, in groups of several batches, the average number per animal being estimated at about fifty. Generally speaking, the eggs take about three weeks to hatch. Slugs, as a rule, arrive

at maturity when a year old, then lay eggs and die. The Black Striped Slug, however, is reputed to live for four or five years.

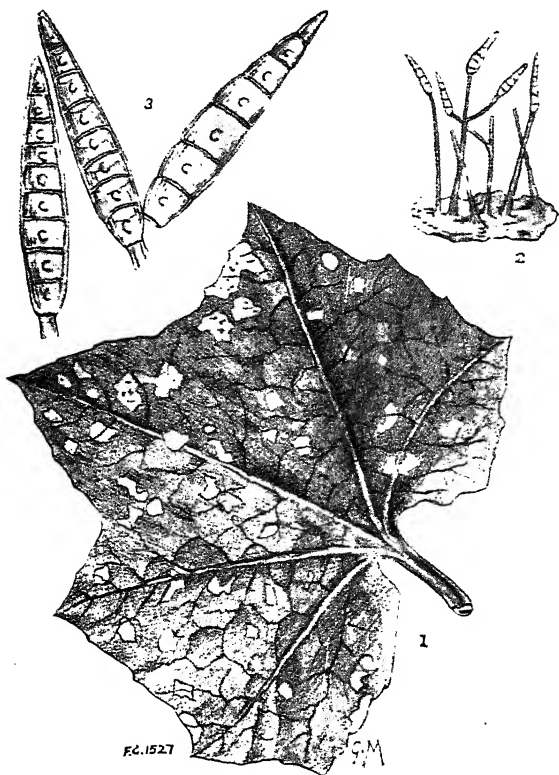
Slugs are nocturnal feeders, and hence are rarely seen by day, except in showery weather. In the daytime they secrete themselves under clods of earth, stones, or in any convenient spot away from sunlight, and during the winter bury themselves in the soil or under rubbish. Their mouths are furnished, as in the case of the snail, with rasp-like, stout, fleshy lips, and small teeth, which renders them capable of devouring tender seedlings and shoots, fruits of the strawberry, as well as often attacking the young tubers of potatoes, with great avidity, and thus slugs must be classed among the most destructive of garden pests. Indeed, the Grey Field Slug has been known to ascend the branches of gooseberries and devour the blossoms. See Coloured Plate.

REMEDIES.—We now pass on to the question of remedies for eradicating or circumventing the destructive propensities of slugs and snails. Of these there are many, which are more or less effective.

Birds.—Many of these are the natural enemies of slugs and snails. Among the most active of these may be mentioned the red start, rook, starling, lapwing, corncrake, wagtails, robin redbreast (eggs only of snails and slugs), wren (small slugs), thrush, blackbird, missel thrush, magpie, jay, and wood pigeon. The thrush is especially partial to snails.

Lime and Soot.—Fresh, finely-powdered lime, owing to its caustic nature, is very harmful to slugs or snails. To be effective, it should be applied early in the morning, just when the slugs and snails are retiring to rest. The action of the lime burns the under surface of the bodies of the animals, and causes the slugs to freely exude fresh supplies of slime to counteract the lime, an effort which weakens their progress. If a second or third dose be applied, at intervals of a quarter of an hour, the animals will be destroyed. Soot is also nearly as good as lime, if used in a similar manner.

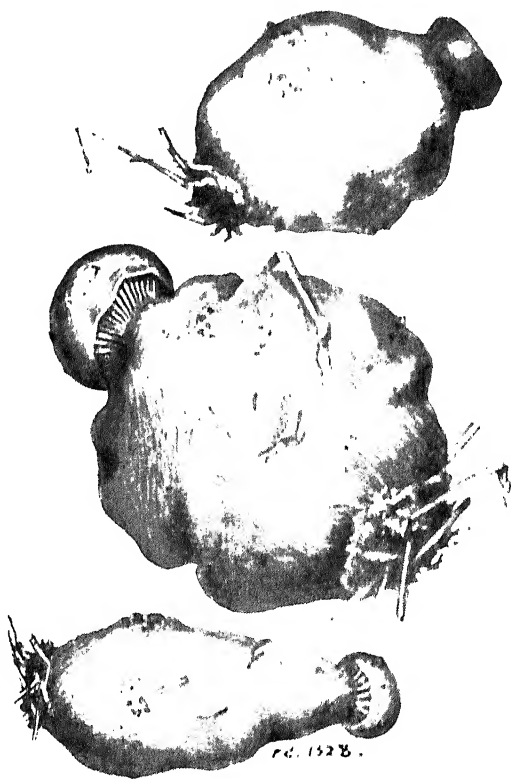
Salt and Lime.—Vacant land infested with slugs or snails may be dressed with 1 oz. of salt and 4 ozs. of powdered fresh lime per square yard a few weeks before



CUCUMBER AND MELON LEAF BLOTCH (CERCO-
SPORA MELONIS).

1. Infected Leaf. 2. Magnified view of the fungus. 3. Fruit of the
fungus. (See Cucumber Pests, page 37.)

[From Board of Agriculture Leaflet.]



PL. 1528.

MUSHROOM DISEASE. (HYPOMYCES PERNICIOSUS)

Causes mushrooms to grow with swollen and distorted stems.
(See Mushroom Pests, page 31.)

[By permission of the Board of Agriculture.]

planting, forking it well into the soil. This destroys slugs hibernating in the soil, also the unhatched eggs. Must not be used if the land is cropped.

Gas-lime.—Very effective if applied to the surface of vacant land in autumn at the rate of 1 lb. per square yard, allowed to remain on the surface two months, then dug in. Destroys the ova or eggs of slugs and snails, also hibernating slugs.

Cinder Ashes.—Fine cinder ashes spread thickly around the base of choice plants or lilies, or thinly over the surface between seedlings, or along each side, and the ends of rows of peas or beans, makes an effective barrier against the attacks of slugs or snails.

Soil Fumigants.—A mixture of one part of naphthalene with 15 parts of fresh powdered lime, dug deeply into the soil at the rate of 4 oz. per square yard in autumn or winter, is an equally good remedy. There are also several excellent fumigants in commerce that are equally effective for the same purpose.

Traps.—Snails and slugs are easily trapped by placing heaps of moist bran or oatmeal here and there on the surface. Both slugs and snails are partial to these substances, and may be readily caught feeding thereon. Lettuce or cabbage leaves smeared with lard and laid on the surface will attract the animals, and in the early morning they will be found congregated on or under the leaves. Sheets of brown paper previously well soaked in water and pegged down to the surface by means of a skewer will attract slugs in large numbers on the under side. Pieces of orange peel placed about also form good traps.

Special Points.—Allow no rubbish to accumulate in the garden, because this forms a rendezvous for slugs and snails, and also a suitable breeding ground for them.

Frequently examine the bases of fences, ivy-covered walls, crevices in rockeries, the rootstocks of hardy ferns, etc., in winter. Snails usually congregate there in colonies and should be promptly collected and destroyed. Every snail you kill in winter means hundreds less young ones in future.

Do not overlook the fact that, although you may do your best to destroy slugs and snails in your own garden,

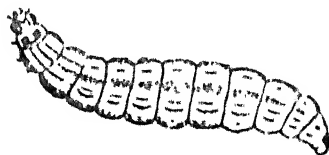
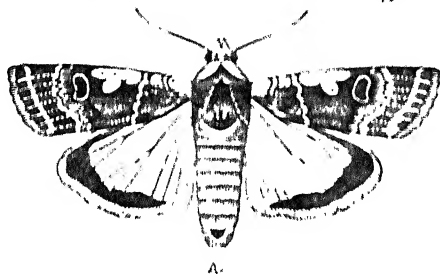
your neighbours may not do so in theirs, hence the animals may find their way through openings in the fence into your garden.

There is no royal road to the effective banishment of these pests. To keep them in check by adopting one of the foregoing remedies is all you can hope to do. It is a case of waging a perpetual warfare against them.

Lastly, do not overlook the value of the toad in your garden; he has a ravenous appetite for young slugs and snails.

Great Yellow Underwing Moth (*Griphæna pronuba*).

This is one of the nocturnal or night flying moths with pale brown to rich amber upper wings and orange-yellow under wings banded on the margin with black.



B.

YELLOW UNDERWING MOTH (*GRIPHÆNA PRONUBA*)

A. Moth. B. Larva. Both natural size

They are sluggish in movement and easily caught in the evening. The larva, when fully grown, average $1\frac{1}{2}$ in. in length, have fat, velvety, greenish or rosy-brownish bodies, with lines and spots of other colours. When disturbed they roll themselves into a ring. The female moth deposits its eggs on lettuce and various plants in June

and July and the larvæ appear in twelve to fourteen days. These feed at night only, hiding in the soil by day. They attack the roots of turnips, radishes, parsnips, and onions, and the stems and leaves of lettuce plants, remain in the larval stage all the winter, become active again in early spring, then change into a smooth red-brown chrysalis and pupate in an oval earthen cell in the soil. See Coloured Plate.

REMEDIES.—Hand picking, and as advised for the Heart and Dart Moth.

MINT.

Mint Rust (*Puccinia menthæ*).—This is a parasitic fungus which attacks the stems of mint and allied plants, causing them to become swollen and distorted, and utterly spoiling the foliage for culinary use. The fungus appears first in orange-coloured masses on the stems, and later on as blackish-brown powdery pustules on the leaves.

REMEDIES.—There is only one, and that is of a drastic character, namely, lift the infected plants and burn them. It is useless applying fungicides. Dress the ground afterwards with ground lime, and grow mint in a fresh plot.

MUSHROOM.

Mushroom Disease.—Mushrooms are sometimes attacked in an early period of their growth by a minute parasitic fungus (*Hypomyces perniciosus*), the mycelium of which develops in the mushroom and causes the stem to assume a swollen, bulbous-like mass of growth. The infected mushroom consequently fails to grow properly, and the stem eventually changes into a putrid mass, emitting a disagreeable smell. The spores of the parasite are no doubt, introduced into the mushroom bed with the spawn or the manure.

REMEDIES.—Any mushrooms which do not develop properly, or have swollen stems, with scarcely any caps or heads to them, should be removed and burnt. In the case of a severe attack, remove the whole of the manure and

soil right away from the neighbourhood of the beds, and then spray the roof, walls, and floor of the mushroom house with a solution of one pound of sulphate of copper to fifteen gallons of water. The spraying should be done three times, at intervals of ten days. During this period keep the house warm and moist to encourage the fungi to grow and be more easily killed by the copper solution.

Mushroom Beetles.—A species of Rove Beetle (*Quedius lateralis*) and of Dung Beetle (*Aphodius*) occasionally do injury to mushroom crops, eating the young and mature mushrooms, and disfiguring them for use or sale.

REMEDIES.—In case of crops being injured thus, trap the beetles by placing pieces of liver here and there on the beds. As these beetles are carnivorous as well as vegetable feeders, they will greedily feed on the liver, and be thus easily caught. Slates smeared with tar and placed on the beds will also catch the beetles.

Mushroom Pest (*Sciara ingenua*).—These active little insects often infest mushroom beds, and do considerable injury to the crop.

REMEDIES.—Spray the walls, soil, and floor before spawning with $2\frac{1}{2}$ per cent. of lysol; or dissolve two ounces of salt in a gallon of tepid water, and sprinkle the beds after soiling with this.

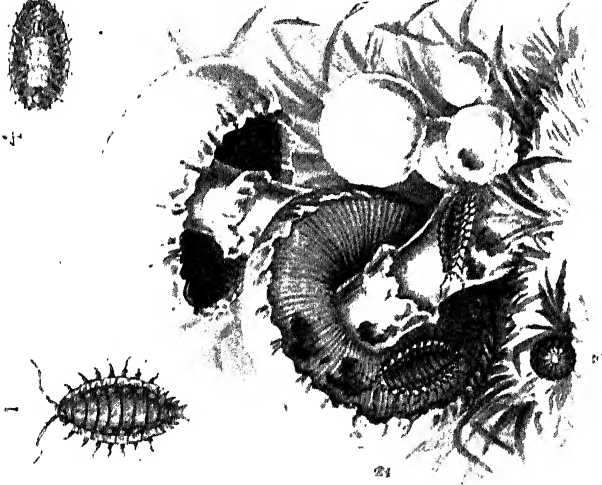
Woodlice.—Two kinds of woodlice prove troublesome pests in greenhouses, frames and mushroom houses. One is popularly known as the "Slater" or "Flat Woodlouse" (*Oniscus asellus*). It has a broad, flat greyish body. The other kind is known as the "Pill Woodlouse" or "Sow-bug" (*Armadillo vulgaris*). This has a shiny, slaty-grey body, and has the habit, when disturbed or at rest, of rolling itself into a ball. Both kinds reproduce their progeny from eggs laid in summer in a special pouch. The young hatch in the pouch and remain for a time with their parents. They belong to the Crustacean order, feed at night, and hide in crevices by day. See Coloured Plate.

REMEDIES.—Being night feeders they are difficult to



THE COMMON EARIWIG

1.—Adult male. 2.—Larva on flower. 3.—Pupa on leaf. 4.—Female.



AG 656

THE FLAT WOODLOUSE

ONISCUS ASELLUS.
1.—Woodlouse enlarged. 2.—Feeding on a mushroom. 3.—Condition when disturbed. 4.—Female carrying a row of 12 eggs.

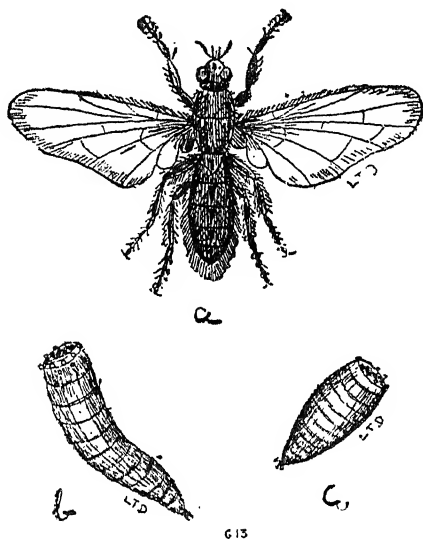
detect. As they congregate, when not feeding, among rubbish and in crevices of walls and floors, their numbers may be considerably reduced by pouring boiling water on the rubbish and walls. Traps, consisting of dirty flower-pots half-filled with moss and laid on their sides, and potato tubers or mangolds with their interiors scooped out, form an excellent means of catching Woodlice. Beetle poison spread on bread and butter and laid about the beds will lure them to destruction.

ONION.

Onion Fly Maggot (*Hylemia antiqua*).—Even more troublesome and destructive than the Carrot Fly Maggot are the larvæ of the Onion Fly, described in some works as *Anthonomia* or *Phorbia ceparum*, but according to the latest authorities, *Hylemia antiqua*. It is a two-winged fly, hence belongs to the order Diptera, and is not unlike the Common House Fly (*Musca domestica*). The body is of an ashey-grey colour, sparingly covered with fine hairs, and the male fly has a few black stripes across its body.

The female flies make their first appearance in May or June, and at once set to work to deposit their white oval eggs in clusters on the base of the young leaves of the onions. The maggots or larvæ hatch in the course of a week, and then descend to the base of the bulbs, and gnaw their way into the interior. They are white, shining, and fleshy, and devoid of legs. The head of the maggot is pointed, and the tail truncated or blunt, and furnished with small points or tubercles. The average length of a fully-developed maggot is about $\frac{3}{4}$ in. Sometimes only one maggot may be found in a bulb, and at other times as many as half a dozen may be present. The result of their presence in the bulbs is the yellowing and sickening of the leaves, and the cessation of active growth. They exist in the larval stage from three to four weeks, then quit the bulbs, as a rule, and pupate in the surrounding soil for about a fortnight, then emerge as flies and again lay eggs. In some seasons as many as three broods may be produced, the last hibernating as pupæ in the soil until the following May. The pupæ are

oval in shape, chestnut-brown in colour, and about $\frac{1}{4}$ in. in length. This pest attacks the onion, shallot, and garlic, but more particularly the two first-named. Apart from causing the leaves to turn yellow, the maggots are also responsible for the rotting of the flesh of the bulbs, and thus producing a putrid offensive odour therefrom. Bulbs infested cannot develop; they gradually go into a slimy, rotten state. See Coloured Plate.



ONION FLY (*HYLEMIA ANTIQUA*).

A. Perfect insect. B. Larva. C. Pupa. All magnified.

REMEDIES.—Directly seedling onions are observed to become yellowish or whitish, and more or less flabby in their foliage, pull up each plant, and cut open the bulbs to see if maggots are present, and, if so, throw these into a pail, and afterwards burn them. Never throw infested plants on the rubbish heap, because any maggots therein will certainly pupate and appear as flies later on. Into the holes from whence the plants were lifted pour a mixture of paraffin oil and soapy water to destroy any maggots in the

soil, and so prevent them travelling to the next healthy plant or plants.

The plot in which infested onions have been grown should be deeply dug in autumn, placing the upper three inches of soil in the bottom of the trench, strewing fresh lime and also a soil fumigant, such as we advised for the Carrot Maggot, over it. A fumigant should also be freely mixed with the remaining soil so as to destroy, as far as possible, any pupæ or chrysalids present therein.

Various methods of preventing the flies depositing their eggs on the young plants should also be tried. One is to draw up mould on each side of the plants to just cover the neck of the bulbs; this being said to prevent the flies finding a suitable position for egg laying. Another is to strew sand and paraffin over the surface of the ground, as advised for the Carrot Maggot, and then to give a good watering. Yet another plan is to dissolve 1lb. of soft soap in a gallon of boiling water, and add one pint of paraffin oil, thoroughly mixing the two. To one part of this solution add thirty parts of water, and apply this to the soil and seedlings. This will not only drive the flies away, but also kill the eggs or young maggots before they enter the bulbs. Spraying the young onions in May and June with a paraffin emulsion is also an effective remedy. See Insecticide Formulæ, Part II. Apply the liquid by means of a pneumatic sprayer or fine spraying syringe to the plants two or three times a week.

Once the maggots are in the bulbs, remedies are useless, as the mischief is too far wrought to save the crop. Nor is it advisable to grow onions on the same plot a second year.

Onion Mildew (*Peronospora schleideni*).—A fungus which frequently does serious injury to the onion crop. It occurs in the form of a mould on the leaves. At first its presence may be detected by yellowish patches, followed later by a white, and then a greyish-lilac mould. The disease causes the leaves to shrivel and the growth of the bulb to be stunted. As a rule fully grown or nearly so bulbs are not affected; it is only in the early stages of growth that they are injured by the disease.

REMEDIES.—Mix one part of slaked lime with two of

CHARACTER FORM.

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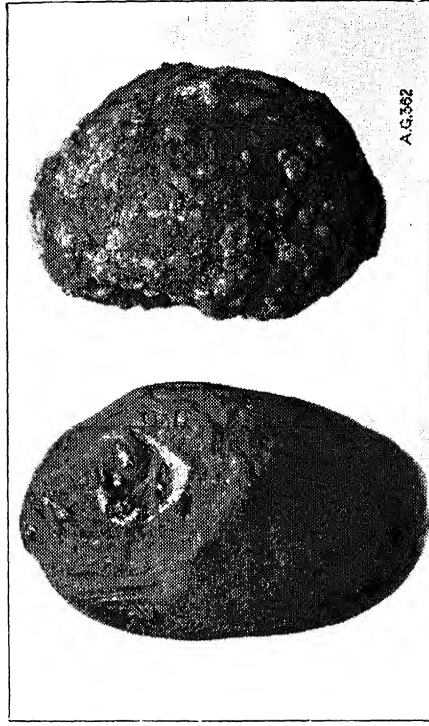
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R.G. 264

POTATO WART DISEASE (SYNCHYTRIUM ENDOBIOTICUM).
(See Potato Diseases, page 81.)



A.G.362

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DRY ROT POTATO DISEASE.

A fungus which attacks the tubers after they are stored. Left-hand tuber is in the first stage, and the right-hand one in the later stage of the disease (*Fusarium caeruleum*). (See Potato Pests, page 80.)

Onion Smut (*Urocystis cepulæ*).—This is a fungoid disease supposed to have been introduced with onion seeds imported from America. It appears the disease is very prevalent there, and as onion seeds have been largely imported here during the war, it is possible that it has found its way to England by this means. Anyway, it is a serious disease, and hence it is necessary that it should be promptly identified by growers and steps taken to prevent its wholesale distribution. The disease appears as dark spots or streaks on the leaves of spring and autumn sown plants. In due course the epidermis cracks, exposing to view masses of sooty, powdery spores. The disease eventually spreads to the outer scales of the bulbs. The spores fall on to the soil and lie there until seedlings appear and then vegetate, the mycelium of the fungus infecting the young leaves and gradually spreading through the tissues. It appears that the spores cannot germinate on the leaves above ground, but only on the lower portions buried in the soil. It therefore can attack young seedlings only. Plants attacked cease to grow and eventually die.

REMEDIES.—The best way to cope with this disease is to at once pull up and burn all plants showing opaque spots or streaks or masses of sooty spores on the leaves. Nor should onions, leeks or shallots be grown on the same site again for many years, since the spores retain their vitality for a long period. If infected plants are not promptly burnt the spores will be conveyed by the agency of wind and insects to other parts of the garden, thus running the risk of future crops being infected.

Eelworms.—Onions in the seedling stage are sometimes attacked by the microscopic organisms known as eelworms. When attacked, the seedlings fail to grow properly, the stems thicken or become distorted, and sometimes split, the result in all cases being a stunted form of development. The illustration (see monochrome plate) shows typical examples of infested onions, such being popularly termed "gouty." The eelworm responsible is known to science as *Tylenchus devastatrix*; it is a true worm of the nematode group, but so extremely minute that a low power microscope is necessary to render it visible. The worms are almost colourless, slender, pointed at each end, and

wriggle about after the manner of their cognominal prototype. The pest when introduced to the soil by other infested soil, manure, or by planting attacked plants, wanders about until it comes across a suitable host, which it is able to enter by puncturing the outer cells by means of a spear-like apparatus in its head. The irritation set up causes in onions a swelling of the stem tissues. The worms pair within the plant, and the females ultimately discharge a large number of eggs. The male worms live about four weeks, and the females six weeks, so that it is easily seen that an infestation can and does spread rapidly.

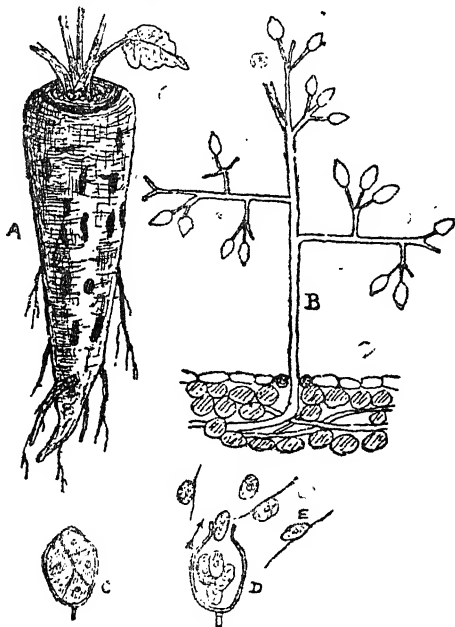
REMEDIES. -Unfortunately the trouble is not easily got rid of; the common type is a very cosmopolitan creature, and is known to infest between 200 and 300 different plants, chief among which are clover, some grasses, corn crops, asters, shepherd's purse, sow thistle, and other weeds. The first thing is to burn all infested plants, and then to dress the ground with sulphate of potash three parts, and sulphate of ammonia one part at the rate of 2oz. per square yard, or four pounds per square rod, to encourage growth in the healthy plants left. Onions must not be grown on the same site for some years after, unless stern measures are resorted to to clear it. To rid the ground the only certain way at present known is to sterilise the soil by heating or steaming it, raising the temperature to 180 to 200 deg. This is best accomplished in the open by making use of an old bath or dust bin, standing same on bricks three deep and lighting a fire under. Fill the receptacle with soil, moisten if dry, and make thoroughly hot, stirring from time to time that the whole may be thoroughly heated. It would be necessary to go down as deeply as the roots descend. The work of sterilising an area of reasonable dimensions, as above, is considerable, but it has the compensating advantages that in addition to the eelworms, other obnoxious life, vegetable and animal, is also destroyed, and the fertility of the cooked soil is increased.

Another method recommended is to saturate the soil three times at intervals of a fortnight with carbolic acid and water, one part acid to twenty parts water. The

soil must be left six weeks afterwards before sowing or planting.

PARSLEY.

Hares and Rabbits.—Both the Brown Hare (*Lepus europæus*) and the Rabbit (*Lepus cuniculus*) do considerable harm to green crops and parsley in winter, and to carrots and other crops in summer. Hares are particularly partial to parsley, and rabbits to the foliage of young carrots. We have known the entire crop of foliage to



MILDEW OF PARSNIPS (*PLASMOPARA NIVEA*).

A. A spotted parsnip. B. Conidiophore bearing cinioia (spores) $\times 100$. C. Mature conidium dividing $\times 500$. D. Conidium after division, the formation of zoospores, $\times 500$. E. Zoospore with cilia, $\times 500$.

be devoured in a single night. Both rodents are very active in snowy or frosty weather when their natural food is scarce.

REMEDIES.—The best remedy is undoubtedly the preventive one of surrounding open gardens or plots with wire netting, and this should be not less than 4ft. in width. Open a trench a foot deep and wide, and place the lower edge of the netting in this, with a slight outward sloping bed, fill up with soil trodden down firmly. It is also a good plan to coat the buried portion with gas tar, and also the exposed portion to the height of a foot. The burying of the lower foot in the soil renders it difficult for the rabbit to burrow under, and the coating of tar is obnoxious to hares and rabbits. Snaring and shooting are other remedies. A strand of freshly-tarred twine or rope affixed to stakes a foot from the ground, and run around the bed or plot, will prevent hares or rabbits attacking the crops.

PARSNIP.

Parsnip Mildew (*Plasmopara nivea*).—The roots of parsnips are sometimes attacked by the foregoing fungus, which causes the former to become putrescent and unfit for food or sale.

REMEDY.—All roots that show signs of going rotten should be promptly burnt, to destroy the fungus and prevent the latter spreading another season.

See Leather Jacket Grub, Dart, Heart and Dart, and Yellow Under-wing Moth. Also Carrot Fly Maggot.

PEA.

Black Root Rot (*Phytophthora omnivora*).—A fungal disease which attacks the roots and base of the stems of peas and causes them to shrivel, turn black and die, as a result of which occurs the yellowing and wilting of the foliage. The mycelium of the fungus permeates the tissues, and of course prevents the infected plants carrying out their proper functions. It appears to attack the plants in their seedling stage, especially those grown in sour or badly drained soils. Lupines and violets are also liable to attack.

REMEDIES.—All plants that turn yellow in their foliage and have blackish or brownish roots should be pulled up



CARROT FLY

(PSILA ROSE).
 1.—Root infested with Maggots. 2.—Parent Fly (twice the natural size). 3.—Larva or Maggot (twice natural size). 4.—Pupa (twice natural size). 5.—Eggs laid on surface of root (See p. 31.)

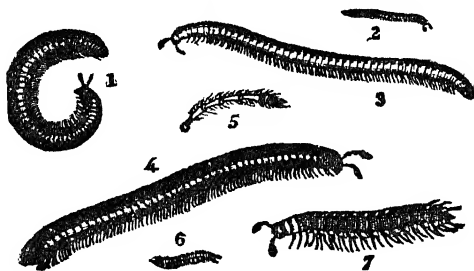
ONION FLY

(HYALIMIA ANTIQUA).
 1.—Bull infested with Maggots. 2.—Fly (slightly magnified). 3.—Bugs laid on leaf. 4.—Pupa (natural size). 5.—Larva or Maggot (twice natural size). (See p. 31.)

AG. 5. 9. 2.

and burnt. Peas should not be grown on the same site again. In the case of a bad attack water the soil with a solution of commercial formalin, one pint to twelve gallons of water. Apply one gallon to each square foot of soil. Cover the surface with sacks or mats for three days to confine the fumes, and do not sow or plant till ten days afterwards. See also that the soil is deeply trenched to drain the surface, and likewise give a dressing of lime. See also chapter on "Sterilisation of Soils."

Millepedes (Julus).—These small active little animals, commonly known as Thousand Feet, are sometimes a source of trouble to the gardener. Although their natural food is supposed to be decaying matter, they are known to attack the seeds of runner and kidney beans and peas soon after sowing, and either destroy the germinating power of the latter or weaken the embryo plant. There are at least three kinds that are hurtful to seeds—namely,

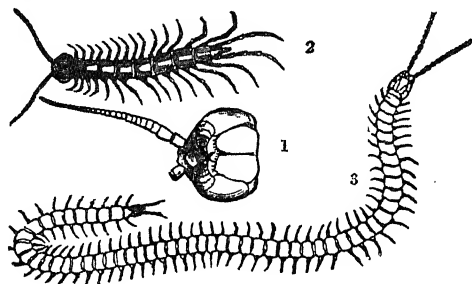


MILLEPEDES, OR FALSE WIREWORMS.

1. *Julus terrestris* curled up. 2. *Julus guttatus*, natural size. 3. Ditto, largely magnified. 4. *Julus terrestris*, natural size. 5. Horn or antenna of 4. 6 and 7. *Polydesmus complanatus* in a young and natural state. These creatures are furnished with numerous legs and therefore easily distinguished from the True Wireworms. They feed on decaying seeds and roots of plants.

Julus pulchellus, an inch long, very slender, with a yellowish or ochreous-coloured body, spotted with crimson; *Julus terrestris*, which is about an inch long, leaden or pitchy in colour, and more or less cylindrical in shape; and *Polydesmus complanatus*, a flat kind with a lilac-tinted body. All are furnished with a large number of legs. The Spotted Millepede (*J. pulchellus*) may be found in

clusters, devouring the seeds, especially in cold, backward seasons, when germination is retarded. They will also attack potato tubers that have been previously injured by wire worms; fruits of the strawberry; lily bulbs, etc. The millepede deposits its eggs in little nests in the soil, and the young appear in about a fortnight. At first they have only three pairs of legs, but as they increase in size additional ones are developed. They are allied to the Centipedes, but are easily distinguished from the latter by their less active movements and the greater number



CENTIPEDES.

1. Head and antennæ of Snake Centipede. 2. Is the Common Centipede (*Lithobius centipatus*), and the other (3) the Snake Centipede (*Geophilus longicornis*). Both are garden friends, and are illustrated to show the distinction between them and the Millepedes, which are more or less injurious.

of legs. Centipedes are friends, not foes. See Coloured Plate.

REMEDIES.—Millepedes abound in leaf mould and other decayed vegetable matter, hence are often introduced to the soil by this means. Where very troublesome they may be readily trapped by burying pieces of cut potato tubers with the insides scooped out beneath the soil. Lift and examine these daily. Dressing the soil in autumn with a soil fumigant, also digging in lime freely, will help to reduce their numbers. See also chapter on the "Sterilisation of Soils," Part II.

Pea Maggot (*Cydea nigricans*).—Those who have grown culinary peas, as well as those who have cooked them, are naturally familiar with maggot-infested pods. The parent of these maggots is a small Tortrix Moth,

named *Cydea nigricans*. The moth is portrayed of natural size in the coloured plate. It appears in June, and then deposits its eggs in twos or threes on the quite young pods. These soon hatch into tiny maggots of a pale yellow or whitish colour, which gnaw their way through the skin, and then commence to feed on the young seeds. When fully fed, the larvæ escape from the pods, descend to the earth, and then enclose themselves in an egg-shaped silken cocoon in the earth in which they remain until spring, when they enter the pupal stage, appearing as moths in June. Early peas are immune from this pest, but maincrop and late kinds are often badly attacked in some seasons. Naturally, their presence in young pods gathered for food is unpleasant, and somewhat disgusting, and hence it is advisable when they are discovered to be careful in shelling the pods, throwing any aside, and subsequently burning or feeding them to poultry, so that there is no chance of the active maggots getting mixed with seeds to be used for cooking. See Coloured Plate.

REMEDIES.—Unfortunately, there is no way of preventing the moths laying their eggs on the embryo pods, nor gaining access to their interiors to destroy them. Generally speaking, it will be found that pods infested with the maggots are deformed, or fail to develop freely. Such pods should be tested, and if larvæ are present, then gather and destroy all similar. Then, again, directly the best pods are gathered for food, make a point of pulling up and forthwith burning all the haulm, and giving the site a good dressing of fresh lime at the rate of 11b. per square yard, forking it in. This will destroy any larvæ present in the soil when they are entering the cocoon stage. Some authorities recommend sprinkling soot freely over the foliage early in the evening in June, so as to deter the moths laying their eggs. All the members of the Tortricina moths are of nocturnal habits, being active only in the evening and night, and resting by day. The Codling and the numerous leaf-rolling moths belong to the same group.

Pea Mildew (*Erysiphe Polygoni*).—A fungus, or powdery form of mildew, which attacks peas very badly

in some seasons, and practically ruins the crop. The fungus first turns the leaves of a yellow tint, then coats the surface with a fine, powdery, white mycelium, similar to ordinary mildew. Soon after this dense coating becomes dotted with small black bodies containing the spores of the mildew. The disease is more prevalent in very dry or very wet seasons. It also attacks beans.

REMEDIES.—Spray with sulphide of potassium and water if the mildew attacks the foliage only very slightly; if badly, the best plan is to burn the plants.

Pea and Bean Thrips (*Frankliniella robusta*).—Minute insects, the larvæ of which do serious injury in some seasons to the flower buds of peas and runner beans and prevent the formation of pods. The female insect deposits her eggs in the unopened blossoms, and the tiny yellowish larvæ appear in ten days. These at once start to feed on the floral organs and cause the flowers to shrivel and eventually fall off, leaving their petioles only behind. Even if pods do attempt to form they become stunted and distorted in growth. They appear to be more numerous in hot, dry weather. See Coloured Plate.

REMEDIES.—The thrips hibernate during the winter under the loose bark of pea and bean sticks, the bark of trees, in dry grass, etc. Hence it is not advisable to use such sticks a second season, but to burn them together with the infested haulm. Nor should peas or beans be grown on the same site again. The soil should also be well limed and deeply dug in autumn.

Pea Seed Beetle (*Bruchus pisi*). — A small beetle which deposits its eggs in the young pods. In due course small curved legless grubs appear, which eat their way into the seeds, feed on the inner parts and afterwards pupate in the cavities formed. Some of the beetles make their appearance in autumn and hibernate in the soil, etc., while others remain in the seeds till spring and escape after the seed is sown. Imported seed is likely to contain this pest. Such seeds usually fail to germinate. See Coloured Plate.



PEA MOTH AND MAGGOT

(*CYDIA NIGRICANS*.)

- 1.—Moth (natural size). 2.—Larva or Maggot.
- 3.—Maggots feeding on pea seeds.

(See p. 62.)

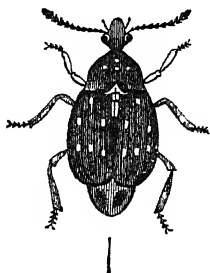


PEA AND BEAN WEEVILS

- 1.—Spotted Pea Weevil (*Sitona crinitus*).
- 2.—Striped Pea Weevil (*Sitona lineatus*).
- 3.—Weevils feeding on the leaves.

(See p. 65.)

REMEDIES.—Practically none of any real service. Seed found infested should be burnt. It is said that exposing

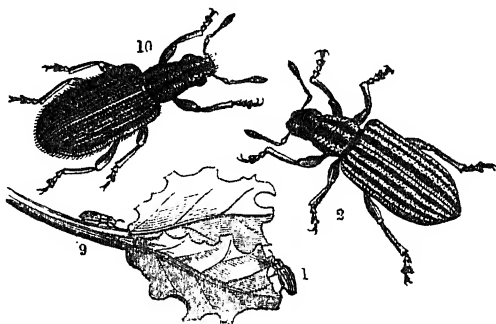


PEA SEED BEETLE
(BRUCHUS PISI).

The short vertical line under the figure of the beetle indicates its natural length

the seeds to a temperature of 125 deg. Fahrenheit will kill the larvæ.

Pea Weevils (*Sitones crinitus* and *lineatus*).—These insects are very troublesome to pea crops in some seasons. The Striped Pea Weevil (*Sitones lineatus*) is probably the worst offender. It measures about a quarter-inch or less



PEA AND BEAN WEEVILS.

1. Striped Weevil (*Sitones lineatus*), natural size. 2. Ditto, magnified. 9. *Sitones crinitus* (Spotted Weevil). 10. Ditto, magnified.

in length, is of a light clay colour, with three whitish or ochreous stripes along its back, and several punctured stripes on its wing-cases. The horns and legs are of a reddish tint. The other kind, the Spotted Pea Weevil

(*Sitones crinitus*), is smaller, of a grey or rosy colour, and spotted with black. These weevils crawl up the stems of the peas, and nibble holes in the edges of the leaves; in bad cases devour the whole of the soft parts. In the larval stage they are found near the roots of clover and peas. They sometimes appear as early as March but chiefly in June and onwards. Beans as well as peas are liable to be attacked. The weevils feed only during bright sunshine; on dull or wet days they hide in the soil. If disturbed ever so slightly when feeding they will instantly drop off the plants and feign death. See Coloured Plate.

REMEDIES.—Spraying the pea and bean seedlings with an arsenate of lead paste wash to poison the leaves seems to be almost the only effective remedy. Sprinkling sand mixed with paraffin, as advised for carrot fly, on each side of the rows will also prevent the weevils attacking the seedlings.

Springtails.—These are lively little insects, which have been noted of late years as frequently infesting the roots of pot plants, also damaging the roots and stems of bulbs, beans, peas, etc. When present in large numbers they undoubtedly do a great deal of harm to the roots of plants. The commonest kind is known as *Podura terrestris*. It varies in length from 1-30th to $\frac{1}{2}$ in., is of a whitish colour, and more or less hairy. When disturbed, it jumps or runs away with alacrity. This species frequents damp and sour soils mainly. Other kinds of Springtails which are equally harmful are: *Achorutes purpureus*, a brownish insect of similar size to the preceding one; and *Lipura ambulans*, a milky-white kind. They are easily recognised by their habit of jumping or springing when disturbed.

REMEDIES.—Immersing the pots and roots in lime water, as advised for worms; watering the soil with a solution of nitrate of soda at the rate of an ounce per gallon, or with a weak solution of permanganate of potash and water, will destroy these creatures. In the garden they may be got rid of by liberal dressings of lime, or lime and naphthalene (one part of the latter to fifteen of the former). See also chapter on "Sterilisation of Soils," especially the Formalin method.

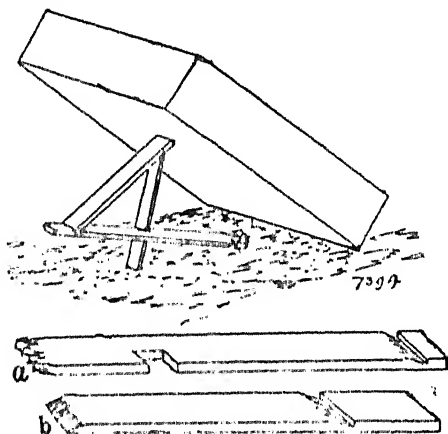
Birds.—Unfortunately, a good deal of ignorance prevails among gardeners as to the real character of bird life in relation to the garden. Because a blackbird or a thrush steals a few cherries or strawberries, a house sparrow mischievously nips off the blooms of crocuses or the leaves of carnations in spring, a chaffinch or a greenfinch purloins a few seeds, or a bullfinch or titmouse vigorously pulls off the fruit buds of gooseberries, etc., in winter, it is at once assumed that these birds are enemies and must be forthwith decimated. Such a notion is a most erroneous one. Birds are friends rather than enemies of the gardener, and should be protected, not destroyed. Surely, if these birds render us such excellent service in decimating the chief pests that attack our crops, we ought not to begrudge them levying a toll on a few fruits as a reward for their services. Is it not wiser on our part to encourage the presence of birds in our gardens, and to protect such crops as are likely to be injured by them?

REMEDIES.—To prevent birds eating seeds, put the latter in a saucer or dish, moisten very slightly, then sprinkle powdered red lead over them, and well stir till the seeds are properly coated. Spread the seeds out to dry, then sow them. A small quantity of paraffin oil sprinkled over the seeds before sowing will be equally efficacious. Rows of peas may be protected by means of pea guards, or by bending sticks over and placing fish-netting thereon.

Mice and Voles.—Two kinds of mice are troublesome to garden crops. The Common or House Mouse (*Mus musculus*) feeds upon pea and bean seeds, grapes, and other crops, indoors and outdoors. The Long-tailed Field Mouse (*Mus sylvaticus*) also feeds upon bulbs, tubers, corms, newly-sown pea seeds, and even the roots of carnations, etc. Then there is also the Field Mouse, or Vole (*Arvicola arvalis*), a short, tufted-tailed, blackish mouse, which lives in fields and also gardens, eating the roots of plants, crocus bulbs, etc.; and the Bank Vole (*Arvicola riparia*), also short-tailed and chestnut-coloured, which lives in river-side banks, etc., and feeds on plants.

REMEDIES.—The best remedy for indoor mice is a keen

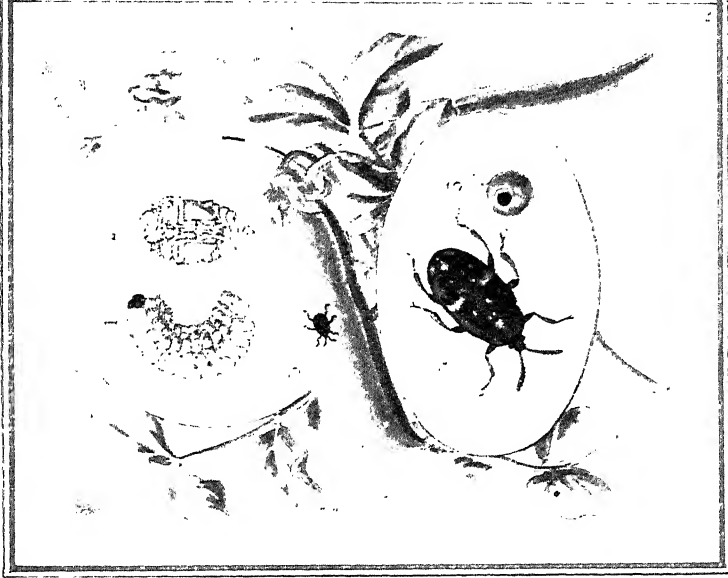
female cat. Other remedies are trapping or using one of the well-known rat poisons. To protect newly-sown pea and bean seeds, add two ounces of aloes to a gallon of water, and soak the seeds for twenty hours in this before sowing. Or mix a tablespoonful of paraffin oil with one quart of seeds, and sow them whilst wet. Seeds, bulbs, and corms placed in water for a short time, then rolled in powdered red lead, will be immune from the attacks of mice. The old "Figure of 4" trap is a simple and effective way of catching mice in the garden. Bait with a piece of toasted cheese, or, better still, with nut kernels. The trap is easily made and put up. If a few of these are always kept baited with toasted cheese they are sure



A SIMPLE MOUSE TRAP.

Commonly known as the Figure of 4 Trap.

to attract any mice within a short distance of the place. It is made as follows: Take a common lath and split it down the centre; then cut an upright piece about 4in. long, the top of which should be made wedge-shape, and the bottom quite flat. Another piece should be made. This should be wedge-shaped at the lower end, and have a notch cut in at the other, to fit on the upright (see A). A third piece, made longer than the others, and extending two or three inches beyond the perpendicular one, should

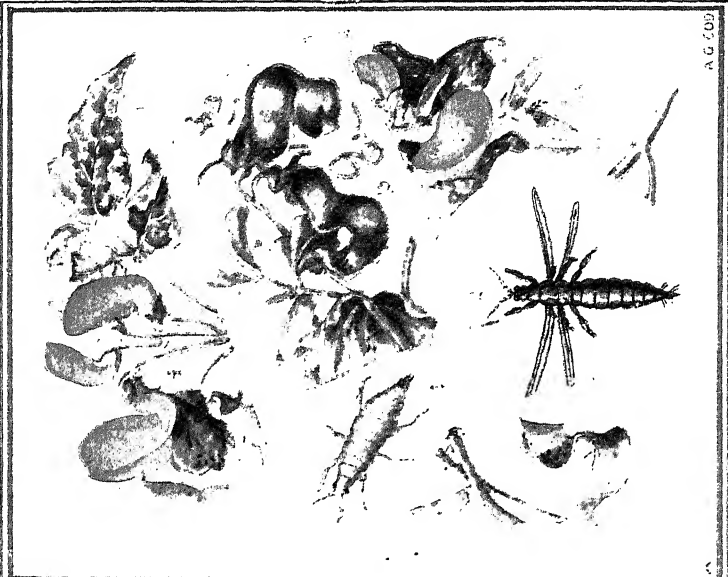


PEA WEEVIL OR BEETLE

(BRUCHUS PISICORUS)

1.—Larva or Grub, 2.—Chrysalis or Pupa, 3.—Eggs and Insect (natural size), 4.—Weevil (enlarged), 5.—Damaged shoot

(See p. 61.)



PEA AND BEAN THRIPS

(GRANKLINELLA ROBUSTA)

1.—Young Thrips, 2.—Fully developed insect, 3.—Injury to Pea blossoms, 4.—Injury to Bean blossoms.

(See p. 61.)



COLORADO BEETLE AND LARVA (DORYPHORA DECEMLINEATA)

next be made (see B). On the end of this the bait should be tied. The front end has a notch cut in to receive the wedge of the slanting piece, and another is cut on the side so as to take the upright. A slate or tile should be laid on the ground, and near one end the upright piece be stood. Bring the slanting one next in position, the end with the cut made in it being placed on the top of the other, the lower end of which is made to fit into the horizontal one. The weight of the slate or tile resting on the upper end of the slanting piece will hold them in position until something pulls at the bait, when the whole falls down together.

Other Pests.—See also Snails, Slugs, Birds, and Millepedes.

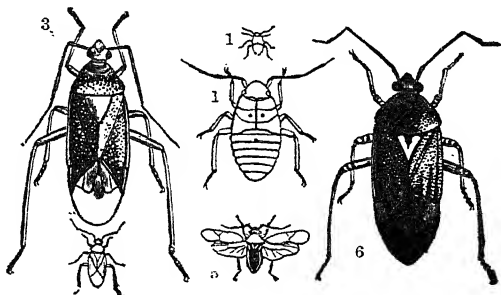
POTATO.

Colorado Beetle (*Doryphora decemlineata*).—A pest of American origin. The female beetle is just under half an inch in length, the male being slightly smaller, and the colour is yellow marked with five longitudinal dark lines on each wing-case. The legs are red, and the wings of a rosy tint. The eggs are oval, orange in colour, and deposited in clusters of nine to forty under each leaf. The larvæ are of a dull reddish-brown colour, and about an inch long when fully grown. They feed ravenously on the foliage till they attain maturity, then descend and pupate in the soil. In America several broods are produced in one season. The beetles are very hardy, and survive the winter in the soil or among rough herbage.

REMEDIES.—Fortunately, this pest has not been seen in this country for many years, but if it should make its appearance it is well to remember that under the Destructive Insects and Pests Act, 1908, immediate notification thereof must be sent to the local inspector of the Ministry of Agriculture.

Plant Bug (*Lygus pratensis*).—Active little insects furnished with a rostrum, or beak, by means of which they puncture the leaves and feed on the sap. They have green to dark shining bodies, are most abundant in summer, and occasionally do considerable harm to the

potato and other crops by puncturing the leaves, and causing discoloured patches to form thereon. Egg laying usually takes place in May. A second species, *L. umbellatarum*, also attacks the foliage.

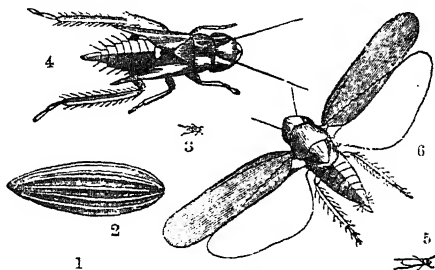


POTATO PLANT BUGS.

2. *Lygus pratensis* (natural size). 3. Ditto (magnified). 1. The larvæ (natural size and magnified). 5. *Lygus umbellatarum* (natural size). 6. Ditto (magnified).

REMEDIES.—Spraying with an insecticide, such as Burgundy or Bordeaux Mixture generally proves effective. Another plan is to draw tarred sacks over infested potato haulm.

Potato Frogfly (*Chlorita solani*).—A species of Leaf Hopper or Frogfly which can often be seen in August and



POTATO FROG-FLY (*CHLORITA SOLANI*).

1 and 2. Eggs (natural size and magnified). 3 and 4. Pupæ (natural size and magnified). 5 and 6. Mature insect (natural size and magnified)

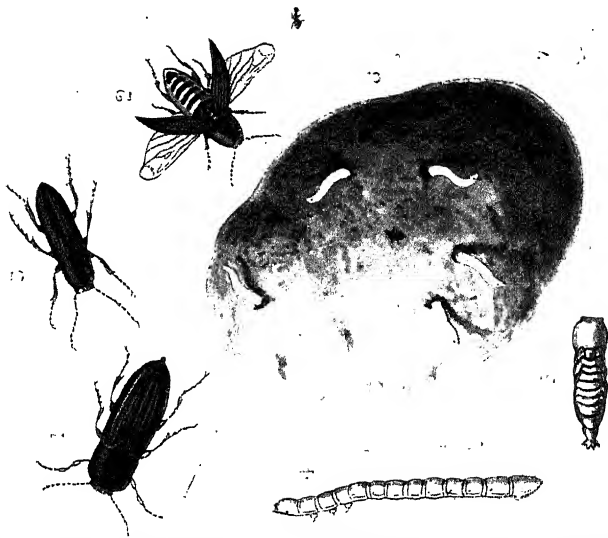
September swarming in large numbers up on the haulm of potatoes. The flies are very small, have long sharp

beaks by means of which they pierce the leaves and suck out the sap, causing the leaves to be spotted. They are very agile, hopping off when disturbed. The flies lay their minute white-ribbed eggs on the under sides of the leaves and the green lice or larvæ feed thereon for a time, then pupate and emerge as flies.

REMEDIES.—If they are numerous the haulm should be sprayed with a strong solution of soft soap and quassia.

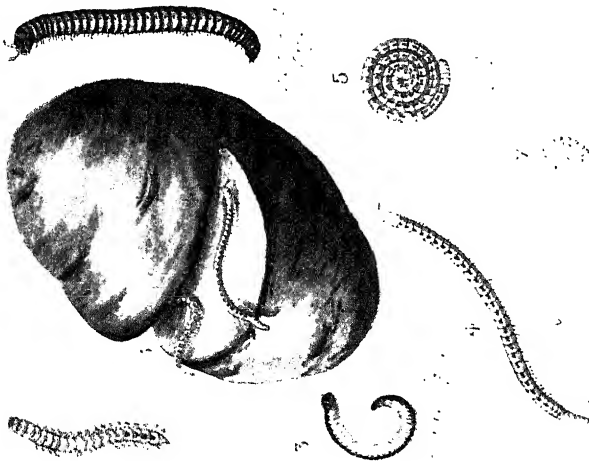
The Wireworm.—The grub known as the wireworm is the larva of a family of beetles scientifically called the Elateridæ. It derives its name from the fact of its possessing a horny or wire-like body, which can be readily snapped in twain. The particular genus of beetles producing wireworms is *Elater*, or, according to some authorities, *Agriotes*, but the former is the recognised generic name. There are at least three species of *Elater* that produce wireworms, namely, *E. lineatus*, *E. sputator*, and *obscurus*. The two figured in the coloured plate, are, however, the most common and harmful ones. The beetles are popularly known as "Click" or "Skip Jack" Beetles, the former referring to the habit of the beetles bending their bodies and emitting a clicking sound by the movements of their wings, and the latter to the beetle when laid on its back suddenly jumping or skipping in the air to recover its normal position. The larvæ attack the roots of carrots, potatoes, tomatoes, corn, strawberries, carnations, etc., and often seriously injure such crops.

The beetles are provided with strong wings by means of which they may be seen flying about freely in bright sunshine or basking on herbage later in the day. They appear from May to July, and deposit their eggs on or just beneath the soil among grass or other thick herbage in gardens or pastures. The eggs are very small, oval in shape, and of a yellowish-white colour. These give birth to tiny larvæ, which feed on the roots of adjoining plants. After a time they become very voracious and gnaw their way into the tubers of potatoes, or into the underground stems or roots of tomatoes, carnations, carrots, etc., and soon do serious damage. The larvæ or wireworm, when fully grown, averages nearly an inch in length, has a yellowish body composed of many segments, a pair of



WIREWORMS AND CLICK BEETLES.

1 & 2.—Beetles (*Elater lineatus*). 3.—Beetle (*Elater sputator*).
4.—Larva (Wireworm) of *E. lineatus*. 5.—Pupa (slightly magnified). 6.—Wireworm boring into a potato tuber. 7.—Eggs.
(See p. 72.)

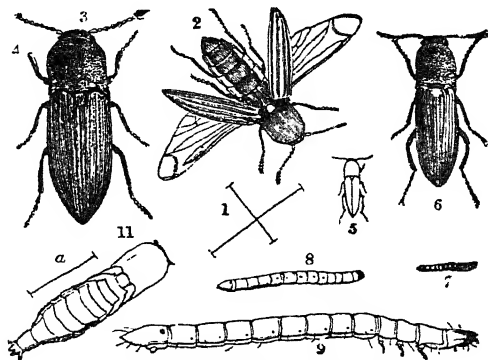


MILLEPEDES.

1.—*Polydesmus complanatus* (Flat Millepede). 2.—*Julius londinensis*.
3.—*Julius punctatus*. 4 & 5.—*Guttatus*. 6.—Millepedes at work.
7.—Eggs.
(See p. 61.)

four-jointed legs on each of the first three segments, and a protuberance under the last segment of the body. The head is hard and horny, and furnished with very powerful jaws, and eyes are wanting.

The larvæ usually feed near the surface of the soil in warm weather, but descend deeper in cooler weather, more especially in the cold days of winter. They can move about freely in light soils, hence are likely to do more mischief to crops in light rather than heavy ones. Wireworms are reputed to live in the larval stage from three



CLICK BEETLES AND WIREWORMS.

Here are shown the True Wireworms or larvæ of the Click Beetle. The larvæ have only six legs in front, and are easily distinguished from the Millepedes, or False Wireworms, also the Centipedes, which have numerous legs, shown in other illustrations on p. 61. 1 and 2. *E. lineatus*. 3 and 4. *E. obscurus*. 5 and 6. *E. sputator* (natural size and magnified). 7. Larva of *E. sputator*. 8 and 9. Larva of *E. lineatus* (natural and magnified). 10. Pupa of Wireworm. 11. Line showing natural length.

to five years. When they attain maturity they descend deeply into the soil, form a cocoon of particles of soil, and then enter the pupal stage, remain thus for about three weeks, then appear as beetles. Wireworms abound to an astonishing degree in weedy land, also in pastures, hence when such land is utilised for arable cultivation they are liable to seriously attack any crops sown or planted therein. See Coloured Plate.

REMEDIES.—So much for the life history of the wireworms, and now to solve the more difficult problem of

West LAMBERT, MO.,

For the control of insects, and especially of the pest in question, it does not appear to be necessary to drive them from the field, but only to drive them to such a degree that they are thoroughly perturbed, so as to reduce their numbers to a point at which they have been made innocuous. The most important of carbon compounds for this purpose is naphthalene. For the purpose of this chemical are used, however, except on a limited scale, only the more volatile and poisonous, it requires great caution. Naphthalene one of the most powerful at the rate of 100 lb. per acre, has also proved successful

It is sometimes advised for the purpose of killing the larvae, to use lime, but the results of repeated experiments have shown that they are useless for this purpose, however, if the soil, where the tint and weeds are growing, is covered with a trench, gas lime, or salt, the larvae will die, but the soil will also destroy the larvae. The soil should be mixed with the upper soil, and the larvae will die.

Portions of cut potato tubers, or other vegetable refuse, and buried a few feet below the surface, will attract the wireworms, and if these are then dug up, and the wireworms fed out, the insects may be destroyed. In this way, hundreds may be

...and the original photo are liable to be destroyed by fire, and hence it is a wise precaution to make the destruction of both. Personal files should be the first removed from the building in the event of a fire, and the same rule can be applied to the same for any other building.

Modern dentistry is a science. Although one naturally feels that the "velvet-coated deniers" of the dental profession are not doing the service they render in the community, the fact remains, however, that the dental profession, in the person of the dentist, is the only one to whom the patient can go for relief of his suffering, and, therefore, we cannot ignore the fact that the dentist is the only one who can help him.

that they do a great deal of damage to our lawns and our flower and vegetable gardens by their active tunnellings beneath the surface. Since we have no means of keeping them out of our gardens, and they will venture therein unbidden, we must, out of regard for our crops, adopt means of capturing them in order to avert further damage.

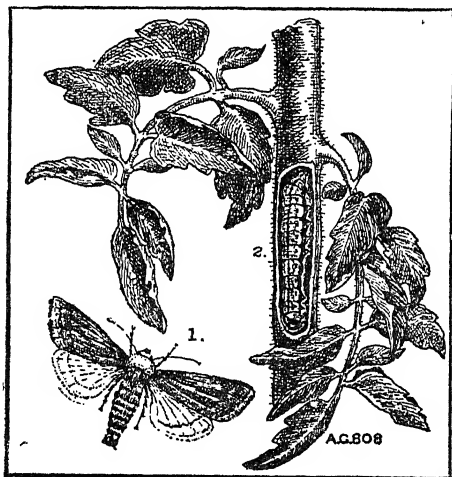
REMEDIES.—The best way of capturing moles is by means of the recognised iron mole trap—set in every “run,” and not in a “mole-hill.” Find out the runs, open the earth with a spade, and then set the trap across the run and cover with soil. Use gloves on the hands when handling the trap, as moles have an acute sense of smell, and would avoid entering it. Moles may be poisoned in the following manner: Collect half a pint of earthworms, get a chemist to add a drachm of strychnine to them; stir well for a few moments; then open holes here and there in the runs, drop in a few worms, and cover with soil. Another excellent remedy is to make the holes here in the runs, place bisulphide of carbon therein, then seal up the holes immediately. Do not inhale the fumes or smoke whilst handling this inflammable and deadly poison. An excellent plan for those who keep retriever or fox terrier dogs, is to train them to watch for moles at work, indicated by the heaving of the soil, and then set the dogs on to catch them. A smart dog will pounce on a mole at once, and bring it out in a moment.

Rats (*Mus decumanus*).—The Common or Brown Rat is a mischievous creature either indoors or outdoors, feeding on seeds, potatoes stored in clamps or cellars, etc., and should be promptly exterminated.

REMEDIES.—(1) The quickest and easiest ways of exterminating rats is to ferret them out. (2) Where this cannot be done, have resort to wire or steel traps. Bait with toasted cheese or bacon, and handle the traps with gloved hands. After the traps are set, sprinkle the following rat scent about the trap: Aniseed, $\frac{1}{2}$ oz.; aquafortis, 3 drops; musk, 1 gr. Mix the musk and the aniseed well together before adding the aquafortis. This scent will attract the rats readily to their doom. (3) Find out their runs, and block them up with broken glass and cement. (4) Rat

poisons. These, however, should only be used where there are no children, pets, or poultry.

Rosy Rustic Moth (*Hydræcia micacea*).—This comparatively modern pest of the potato is an insect with reddish-brown and prettily marked forewings and greyish-brown hindwings. As a rule, the females lay their eggs on Horse-tails and Sedges, but they also apparently lay them on potato leaves. The larvæ, as soon as they are hatched, gnaw their way into the potato stems, feed on the pith, and work their way



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ROSY RUSTIC MOTH (*HYDRÆCIA MICACEA*).

1. The Moth. 2. The larva feeding on the interior of a potato stem.

downwards, the result being the ultimate withering of the stems. See Coloured Plate.

REMEDIES.—Unfortunately, their presence cannot be detected until the stems begin to droop and wither. When this is detected slit the stems open and search for the larvæ.

Death's Head Hawk Moth (*Acherontia atropos*).—Although the larvæ of this moth may occasionally be found on a potato patch, it cannot be regarded as a serious pest,



ROSY RUSTIC MOTH

(HYPERECTA RUFA)

1.—Moth. 2.—Caterpillar or larva feeding in the pith of potato haulm.
3.—Chrysalis or Pupa. 4.—Eggs. (See p. 76.)

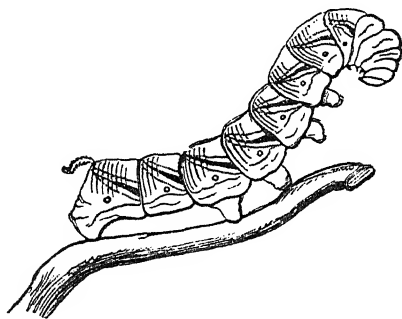
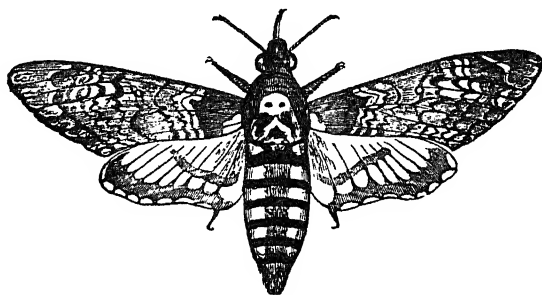


HEART AND DART MOTH

(AGROTIS EXCLAMATIONIS)

1.—Eggs. 2.—Caterpillar or Larva. 3.—Chrysalis or Pupa.
4.—Moth. (See p. 94.)

but rather as an insect of unusual interest. The moth is of large size, averaging 5 to 6in. in the spread of its wings. The forewings are blackish-brown, with tawny markings, and the hindwings yellow with a narrow black band in the centre, and a broader one on the margin. On the thorax are markings resembling a skull, and the body

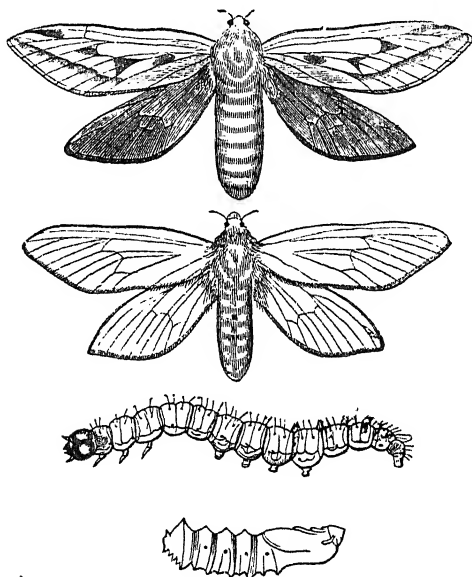


DEATH'S HEAD MOTH (*ACHERONTIA ATROPOS*).

One of the Sphinx or Hawk Moths. Moth and larva half natural size.

is yellow banded with black with a bluish-black stripe down the centre. The larvæ is large, measuring 5 to 6in. in length, and the colour of its body is lemon-yellow with seven oblique violet stripes on each side. The larvæ appear from July to October. The moth is rarely seen. It is partial to honey, and makes a squeaking noise like a mouse. The larvæ and pupæ are occasionally met with when the crop is lifted.

Ghost Swift Moth (*Hepialis humili*).—The larvæ of this moth are sometimes found feeding on the roots of various crops, including potatoes and beans. The male has white wings with a brownish fringe, and the female dull yellow forewings marked with brick-red, and dull lead-coloured hindwings. The moths appear in June, and are



GHOSH OR OTTER MOTH (*HEPIALIS HUMILI*).

The upper figure is the female and the lower, the male moth. Next is the larva and then the pupa.

seen flying about swiftly at dusk. The eggs are supposed to be dropped as the moths fly, and to hatch in about ten days. The larvæ are creamy-white with a brown head, have their bodies covered with short hairs or bristles, and are usually about $1\frac{1}{2}$ inches long when fully grown. They feed on the roots of crops until April, then enter the pupal stage.

REMEDIES.—Digging in deeply in autumn or winter a mixture of naphthalene and lime is the only remedy.

Blight (*Phytophthora infestans*).—This is one of the commonest diseases attacking potatoes. It is more prevalent in wet than in dry seasons, and not only destroys the foliage rapidly, but also attacks the tubers and causes them to rot. The disease appears first of all in the form of dark spots on the leaves, which gradually increase in size and spread over the whole of the haulm, and causes it to turn brown and die. The fungus develops spores on the under sides of the leaves, and these fall on to the soil and are washed down by the rain to the tubers. When a spore comes in contact with a tuber it produces a germ tube which penetrates the skin, develops a fine thread-like growth called mycelium, which penetrates the tissues and causes the decay of the flesh. Tubers attacked show slight stains on the skin at first; later sunken patches occur and dry rot sets in completely destroying the tuber. The disease generally appears from early July onwards to September or later, and in wet weather spreads very rapidly.

REMEDIES.—The best remedy is the preventive one of spraying the foliage with such fungicides as Burgundy Mixture or Bordeaux Mixture. See formulæ in Part II. If this is properly carried out, i.e., the under as well as the upper sides of the leaves covered with a thin film of fungicide, the spores then cannot germinate and infect the tissues. In the southern counties the crop should be sprayed from the middle to the end of June; in the western counties from early to mid July; and in the midland and northern district from mid July to August. At least two sprayings should be given, the second one about three weeks later.

If, unfortunately, the crop should be attacked before spraying, all diseased haulm or portions thereof should be collected and burnt. On no account allow diseased haulm to lie on the ground, nor place it on the rubbish heap, otherwise the spores will be carried by wind or insects to other potato crops in the vicinity. Nor should infected tubers be fed to pigs, but be burnt. Neither is it safe to use tubers for "sets" that were grown on infected land.

Common Scab (*Actinomyces* sp.).—This is not so serious a disease as Corky Scab. It is, however, very prevalent. It is caused in the first instance by the young tubers hav-

ing their skins fractured by coming in contact with cinder ashes, grit, or lime. A minute soil organism gains entrance to the flesh through the fractures and causes scabbed or eroded patches to develop. Fortunately the disease does not affect the edible or storing value of the tubers.

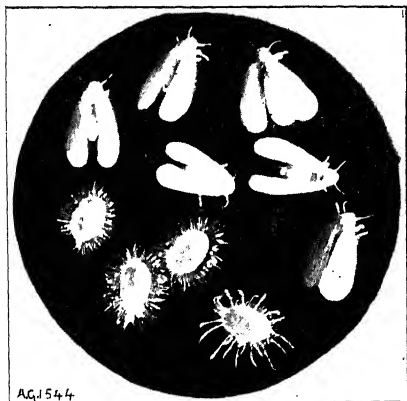
REMEDIES.—Where the crop is likely to be infected by this disease do not apply farmyard manure, soot, lime, or ashes, but superphosphate of lime and sulphate of ammonia. Fork in also flowers of sulphur at the rate of 1 oz. per square yard before planting.

Corky Scab (*Spongospora subterranea*).—This is a destructive disease in Scotland, Ireland, and the northern parts of England and Wales, where the rainfall is heavy and the soil damp. It appears first in the form of small, conical, whitish warts on the surface of the young tubers. Later, the fungus ruptures the skins and reveals the presence of an olive-brown powder, the spores of the fungus. In cases of bad attack scabs form which assume a corky nature, the flesh beneath being destroyed. The liberated spores escape into the soil and of course are capable of attacking any subsequent potato crop.

REMEDIES—Potatoes should not be grown on the same site again for several years. A dressing of flowers of sulphur ($2\frac{1}{2}$ ozs. per square yard) should be dug into the soil prior to planting as a preventive remedy. Scabbed tubers should not be used for "sets," and it is advisable to soak "sets" for three hours in a solution of commercial formalin ($\frac{1}{2}$ pint to 15 gallons of water) before planting.

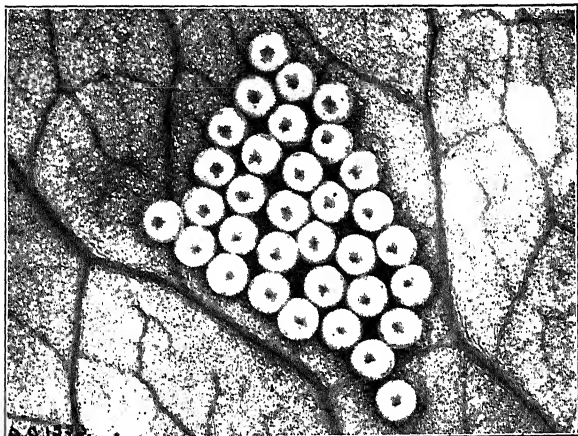
Dry Rot (*Fusarium cæruleum*).—This is a disease which attacks the tubers after they are stored. It usually appears as dark, shrunken patches on the skin. Later the fungus bursts through the skin, and the flesh subsequently becomes brownish and shrunken, eventually becoming a hard, dry mass. Early sorts are the most liable to attack.

REMEDIES.—Sort the tubers over frequently and remove and burn any having shrunken patches on their skins.



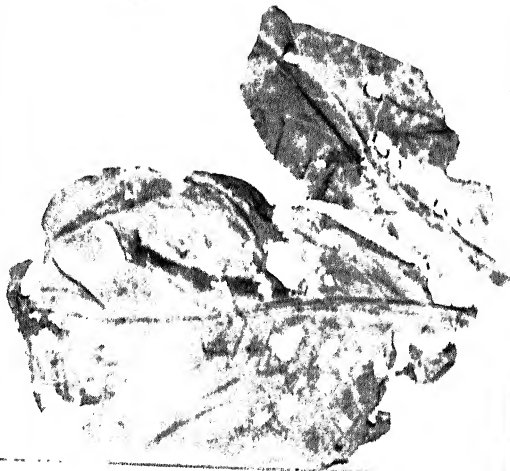
GHOST OR 'SNOW FLY (*ALEYRODES VAPORARIORUM*).

The flies are magnified eight diameters. Below are the waxen nymph cases containing the pupae. (See Tomato Pests, page 86.)



EGGS OF THE CABBAGE MOTH (*MAMESTRA BRASSICÆ*).

The eggs, which are largely magnified, are laid on the under side of the leaf. (See Cabbage Pests, page 20.)



AG749

CABBAGE WHITE RUST.

THEY ARE CAUSED BY THE FUNGUS *Uromyces brassicae*.
See Cabbage Rust, p. 105.



RC1524.

TOMATO ROOT ROT.

THEY ARE CAUSED BY THE FUNGUS *Phytophthora blanda*.
See Root Rot, p. 105.

Care should be taken not to use infected tubers for "sets," as they would not make satisfactory growth.

Leaf Curl.—Sometimes the leaves of potatoes curl inwards and assume a pink, mauve, or yellow hue, and the haulm becomes stunted or dwarfed in growth. Plants so attacked produce few, if any, tubers, and the "sets" fail to decay. The real cause of this disease is not definitely known, but it is believed to be, in a large measure, due to over-ripe seed. It has been noted that crops grown from new Scotch seed do not suffer from leaf-curl.

Wart Disease (*Synchytrium endobioticum*).—This is the most serious of all the diseases attacking the potato. It originally came under notice a few years ago in Lancashire, but since has gradually spread to other parts of the country. It attacks the tubers, mainly commencing at the eyes and gradually developing whitish wart-like growths which in time utterly distort the natural shape of the tubers. After a time the warts assume a blackish hue, and the interior flesh becomes rotten and putrid. Sometimes the leaves and buds of the stems below or just above the soil are also attacked. Occasionally only a single tuber may be attacked; in other cases every tuber, large or small, are furnished with warts. The fungus develops from mobile zoospores, which escape from summer or winter resting spores present in the soil. These zoospores infect the tubers at the eyes only, and the fungus develops in the cells just beneath the surface. When an infested tuber rots the resting spores escape into the soil and it is said are capable of retaining their vitality for many years. If, therefore, potatoes are subsequently planted in infected land, even for some years afterwards, there is a risk of the tubers being attacked. There is no mistaking the identity of this disease.

REMEDIES.—So serious has the Wart Disease become that it threatens to annihilate the potato unless stringent precautions are taken to prevent its distribution. The Ministry of Agriculture has scheduled it as a notifiable disease. Anyone, therefore, discovering its existence in their gar-

dens, farms or plots, must at once send a notification to the Secretary of the Ministry of Agriculture, who will then send an expert to advise as to the treatment of the crop and of the soil. Failure to obey the order renders the grower liable to a penalty of £10. It behoves every grower to faithfully observe the order so as to, as far as possible, prevent the disease spreading.

Tubers infected should not be allowed to remain in or on the soil, nor should be thrown on the rubbish heap; they should be burnt. Certain varieties have proved resistant to the disease, and these only are permitted to be grown in land in infected areas. Even these, however, must not be planted in a plot that has produced diseased tubers. Lists of immune varieties are published annually by the Ministry of Agriculture.

Miscellaneous Potato Diseases.—In addition to those described there are two or three of less importance. "Blackleg" or "Brown Stem Rot" is a disease of bacterial origin. It attacks the base of the haulm, causing it to become rotten and of an inky-black colour. The leaves, too, assume a yellow colour. The tubers are also liable to infection, and these either rot in the ground or soon after storage. "Stalk Disease" attacks potatoes grown in Ireland and in damp northern counties. It first appears as a white mould on the stem, and later the tissues are permeated by the mycelium of the fungus (*Sclerotinia sclerotiorum*), which prevents the passage of the sap, and thus causes the haulm to fall over and die. Does not affect the tubers. Other diseases are "Pink Rot," "Violet Root Rot," "Sprain," "Silver Scurf," and "Internal Rust Spot," but they are not of serious importance.

REMEDIES.—In all the above diseases collect and burn all infected foliage and tubers.

SHALLOTS.

See Onion Pests and Diseases.

SAVOYS.

See Cabbage and Turnip Pests and Diseases.

SWEDE.

See Cabbage and Turnip Pests and Diseases.

SPINACH.

Spinach Mould (*Peronospora effusa*).—A fungus which infests the under sides of the leaves of spinach and allied plants. It forms patches of greyish-lilac mould, and if allowed to remain will rapidly spread and destroy the crop. Fortunately, it is not very common. Weeds like the Goose-foot (*Chenopodium*) should not be allowed to grow where spinach is cultivated, as the fungus is partial to this plant.

REMEDY.—Collect and burn all infected foliage.

Buff Ermine Moth (*Actia lubricipeda*).—This moth technically belongs to the genus *Arctia* of the sub-family Arctiinae, of the order Lepidoptera. It appears to be fairly common in England, Wales, and Ireland, and less so in Scotland, and its larvæ or caterpillars feed on the leaves of such vegetables as spinach, cabbage, lettuce, mint, and peas; also on trees and shrubs, as the apple, elder, rose, brambles, raspberries, and strawberries. The parent moth has buff-coloured forewings with dark spots and slightly paler hindwings. It flies at night only, so is never met with during daylight. The female moths appear in July, lay their eggs in clusters or groups on the leaves in August or early September, sometimes earlier, and the larvæ appear in a short time afterwards, and feed on the various plants until October, when they enter the pupal stage.

The caterpillars are about 1½ in. long, furnished with tubercles on their bodies, from which issue tufts of long, yellowish hairs. An orange dorsal stripe runs down the middle of the back. In feeding they gnaw holes in the leaves, as well as bite off the margins, and hence seriously damage the foliage. As previously mentioned, the larva generally becomes fully grown about October, when it gradually envelops itself with a fine silken web to form a cocoon attached to a portion of the leaf of the plant it has fed upon, either on the plant or on the surface of the ground. In this sanctuary it gradually changes to a dark brown pupa, and remains thus until the following July, when it comes forth as a moth to begin its life mis-

sion of depositing its eggs on favourable host plants. See Coloured Plate.

Remedy. Seeing that the larvæ are sufficiently distinctive in form and size, it naturally follows that the simplest of all remedies is to search for, collect, and destroy them by hand picking. They are not like the larvæ of the Cabbage Butterfly, so plentiful as to need much time or labour in the work of collection. Boys or girls should be encouraged to search for them, in return for a small reward. Dustings of stale soot or slaked lime strewn over the leaves of cabbage or spinach would prove a deterrent to the young larvæ feeding thereon. Dead or damaged leaves lying on the ground are likely to contain the cocoons, and these should be systematically collected and burnt, since every cocoon or pupa found would mean go to ruin to the developing another year.

Insectivorous birds like the Great Tit, Blue Tit, Cole Tit, Red Start, Fly Catchers, Rook, Starling, Water Wagtail, Robin, Wren, Hedge Sparrow, Chaffinch, Thrush, and Blackbird, feed on the larvæ and pupæ, and thus destroy hundreds in the course of a year. If such birds were encouraged rather than discouraged in gardens, there would be far fewer caterpillars to levy a toll on the crops.

TOMATO.

Bacteriosis. Tomatoes as well as potato plants are sometimes attacked by a bacterial organism, which first infects the joints of the stem, and then travels downwards, passing into the leaves, and thence to the roots. The result of infection is the formation of blackish brown blotches on the leaves and dark brown streaks on the stems. The latter when cut across, have their tissues more or less brown in colour. Dark coloured blotches also develop on the fruit and cause the flesh to rot. When plants are infected the leaves wilt, curl up, turn yellow and the plant dies.

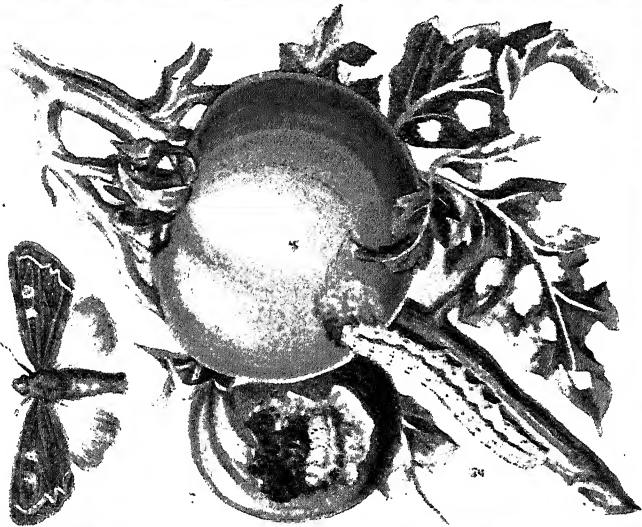
Remedy. Burn diseased plants and sterilise the soil by heat. Take care to obtain seeds that are guaranteed to be saved from healthy fruits only.



SNOWY OR GHOST FLY

(*ALYSIIDAE VAPORARIORUM*).

1.—Fly enlarged. 2.—Damaged leaves and fruit.
(See p. 31.)



HADENA MOTH

(*HADENA OLERACEA*).

1.—Moth. 2.—Caterpillar or Larva. 3.—Larva feeding on a Tomato Fruit.

(See p. 92.)

A.G. 030

K.A.

Black Spot Disease.—Tomato fruits are frequently attacked by a bacterial organism which causes the eye end of the fruit to turn black and decay. The disease attacks the young fruits when the size of a marble, and the spots gradually increase in size as the fruit develops. It is possible that the spores are conveyed to the eye of the young fruits by insects. Anyway, the disease renders the fruit useless for consumption.

REMEDIES.—There is only one satisfactory way of preventing the disease spreading, and that is by gathering and burning every infected fruit. It is quite useless applying fungicides. Nor should seeds be saved from infected fruits. Aphides and other insects should be destroyed by fumigation, as these undoubtedly convey the bacteria when visiting the flowers.

Leaf Rust Disease (*Cladosporium fulvum*).—This fungoid disease first appears in the form of pale yellowish patches on the upper sides of the young leaflets, the spots increasing in size until the whole or a part of the surface is covered. Similar patches develop on the under sides, eventually forming a velvety brown to black covering over the surface. Then the stems of the infected plants also develop rusty blackish stripes thereon. In bad cases the fruit is also affected. Eventually the infected leaves wither and die. This disease is of a virulent nature, and, once established on a plant and not checked, will soon spread and ruin the crop. It has been found by experience that a moist atmosphere, and insufficient ventilation, together with overcrowding, encourage the development of the disease.

REMEDIES.—Once the disease has obtained a firm hold there is no cure. The best plan is to burn the infected plants. Preventive remedies are as follows: Maintain a dry atmosphere and ventilate the house early. Avoid late waterings. If only a solitary leaf is found infected gather and burn it. Spraying with a solution of sulphide of potassium is an excellent preventive. The fruit must be carefully wiped after spraying. One authority recommends wrapping the fruit in oilskin before spraying, but this is a tedious business.

Sleepy Disease (*Fusarium lycopersici*).—A fungoid disease which causes the leaves to assume a dull colour, then droop, and finally the plant to suddenly collapse. It appears that this fungus enters the tissues of the plants through the fine root hairs in the soil. In the course of a few weeks the fungus appears on the lower part of the stem in the form of a white mildew. Eventually the stem becomes covered with orange patches, and then the leaves droop and the plant dies. On cutting the stem through a brownish ring will be found beneath the bark. When the leaves of a tomato gradually droop this may be regarded as evidence of the presence of the fungus.

REMEDIES.—Fungicides are useless in this case. All that can be done is to pull up and burn the plants, and the soil should be removed and dressed with quicklime. Such soil should not again be used for growing tomatoes. The walls, paths, floor, and staging should be syringed with a solution of carbolic acid and water, one part of the former to twenty parts of water.

Snowy or Ghost Fly (*Aleyrodes vaporariorum*).—A small white fly which infests the leaves and fruit of the tomato and greenhouse plants, sucking out the sap and crippling the foliage, as well as coating the surface with its excrement. The eggs are laid in large numbers on the under and also the upper sides of the leaves, and the plants soon become swarmed with active flies, which dart away in cloud-like masses when disturbed. They are closely related to the Scale insects and Aphides. The oval, shiny whitish or greenish eggs are attached to the leaves by short filaments and they hatch in about twelve days. The young insects pierce the epidermis with their beaks and suck out the sap. After a short time they pupate on the leaves and appear as flies. See Coloured Plate.

REMEDIES.—Repeated experiments have clearly demonstrated that there is only one really effective remedy of getting rid of this troublesome pest, and that is by fumigating infested glass houses with hydro-cyanic acid gas. Fumigation with nicotine seems useless, because while it undoubtedly destroys the flies yet it fails to kill the eggs. Hydro-cyanic acid gas, however, destroys both, and so commercial tomato growers now rely solely on

this remedy. An old and very clever scientific market grower friend of the Author's (Mr. W. Dyke, of St. Margaret's, Ware, Herts) has very kindly placed at his disposal the following particulars regarding the application of this remedy:

"Up to within a very short time ago, no definite cure for white fly was known, although for years some of us had been using the very material which will kill it with varying degrees of success. We have to thank Lieut. Lloyd, the entomologist of the Lea Valley Experimental Station, Cheshunt, for what we know to-day regarding white fly and its eradication. For some time he has devoted all his energies on this pest, and, thanks to him, we now have a remedy which will keep it under control. It is only those who are in close touch with his work who know what a laborious task he has had, and we could describe some interesting things which occurred during the thousands of experiments which he carried out.

"For years we have been using hydro-cyanic acid gas with varying degrees of success, for destroying white fly on tomatoes. Sometimes it killed them, sometimes it did not. Sometimes it burnt the foliage badly, and sometimes it did not. The reasons for the success and failure are now known, and the information we shall now give will prove that there is nothing equal to the above gas for destroying the pest.

"The reason for the failure to eradicate the pest was due to the fact that, while the gas would kill the fly, it would not kill the eggs, with the result that in a short time the flies hatched out from the eggs, and the pest was as bad as ever. To overcome this difficulty, it is necessary to give two fumigations, one to kill all mature flies, the other at a definite period later, i.e., when all the eggs have hatched, but before the new flies are old enough to start laying eggs. The second fumigation should be given three weeks after the first in warm weather, and a month after the first if the weather is cold.

"Hydro-cyanic acid gas burns the foliage of some plants when they are soft and sappy, when the temperature of the house is high, or if the fumigation is done during sunlight. To overcome these difficulties, the plants should be kept on the dry side, i.e., the soil in which

they are growing should be nearly dry, it should only be done on cool evenings, and never done in daylight.

"The first thing to do is to find out how many cubic feet of air space there is in the house or frame to be fumigated. To ascertain the cubical contents of a span or lean-to greenhouse in order to know the exact quantity of fumigating material required, as described in a following article, proceed as follows: In the case of a span-roof greenhouse (Fig 1), multiply the length C to D by the breadth A to B, and the total by the average height, B to E, shown by the dotted lines, and the result will give

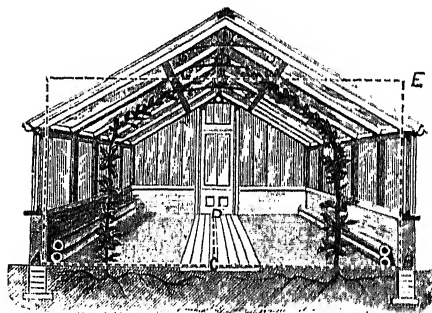


FIG. 1.—SPAN-ROOF.

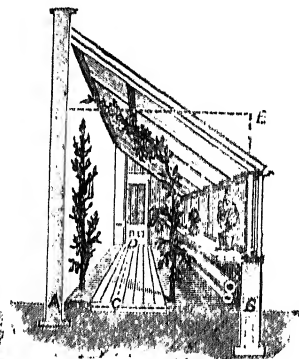
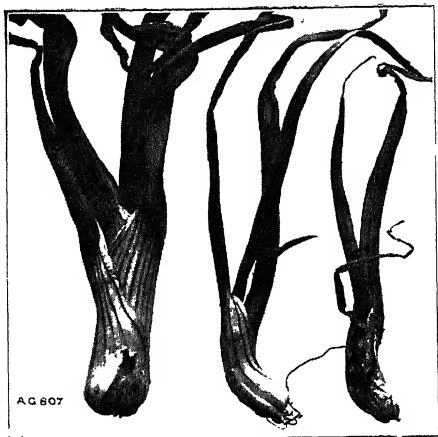


FIG. 2.—LEAN-TO.

Diagrams showing method of ascertaining cubical contents of greenhouses for fumigating purposes.

the cubical contents. Proceed in a similar manner with a lean-to structure (Fig. 2); that is, multiply the length C to D by the breadth A to B, and the total by the average height, B to E. The dotted lines show the directions in which the measurements should be taken. The portions of the roofs above the dotted lines E E are allowed for by assuming that the angles of the dotted lines E to B represent space equal to these. The measurements are, of course, taken in lineal feet, which, when multiplied, convert the results into cubic feet.

"Having ascertained how many cubic feet the house or frame contains, the next thing is to determine whether the structure is fairly air-tight or leaking. If the struc-



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ONIONS INFESTED WITH EELWORMS.
 (See Onion Pests, page 67.)



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COMMON POTATO SCAB.
 (See Potato Pests, page 79.)



TOMATOES ATTACKED BY BLACK SPOT DISEASE
(See Tomato Pests, page 85.)



TOMATO LEAVES WITH WARTY VEINS.
(Result of too liberal feeding.)

ture is fairly air-tight $\frac{1}{4}$ oz. of cyanide of soda per 1,000 cubic feet of air space is all that is needed. If the house is leaking, then $\frac{1}{2}$ oz. per 1,000ft. will be needed.

"Cyanide of soda and sulphuric acid can be purchased from most chemists. If the house to be fumigated contained 1,000 cubic feet of air space, and was not a leaky structure, then $\frac{1}{4}$ oz. of cyanide, and $\frac{1}{2}$ a fluid ounce of sulphuric acid would be needed. If there were 4,000 cubic feet of air space then 1oz. of cyanide and 2 fluid ounces of sulphuric acid would be necessary. It can be seen by this that once the cubical contents of the house or frame are known, the calculation of the quantity of material required is a very simple matter.

"The most material that can be used in any one jar is 1oz. of cyanide, and so should there be more than 4,000 feet of air space, two or more jars would be needed.

"To fumigate the house, the following directions must be carried out without the slightest variation. If the house contains up to 4,000 cubic feet of air space, then procure a 1lb. jam jar. In this pour 4 fluid ounces of clean water, and then 2 fluid ounces of sulphuric acid. Remember always water first, acid second. The jar with its contents is placed in the middle of the house. This should be done before dusk. When it is just getting dusk, take 1oz. of cyanide of soda lying loose on a sheet of strong paper, and tip the cyanide into the jar. Immediately this is done, leave the house and lock it up, because the very instant the cyanide of soda falls into the acid and water, a deadly poisonous gas (hydro-cyanic acid gas) is liberated. Under no condition must the house be entered until the following morning, and then not until the door has been left open for an hour or so.

"If there is more than one jar needed, then the jars must be prepared as already stated, and the cyanide of soda placed on thick paper by the side of the jars. When everything is in readiness, start at the jar farthest from the door, tip the cyanide in, and pass on quickly to the next jar, repeating the operation, and so on until the door is reached. There is no danger so long as the tipping in of the cyanide is done quickly, and the operator moves away as fast as he can to the last jar, and out of the house, but there must not be any delay from start to

finish. Millions of cubic feet of tomato houses have been fumigated in the Lea Valley, and in no case has there been the slightest mishap.

"We would, however, warn readers against two things—firstly, that cyanide of soda is a deadly poison, and so is the gas, which is liberated when it is put into the water and acid; and, secondly, that it would be a dangerous thing to try and fumigate a greenhouse, which is attached to a dwelling-house, if there be either door or window opening into it."

Tomato Leaf Spot (*Septoria Lycopersica*).—This is a fungoid disease supposed to have been introduced from America with imported tomatoes. Anyway it is a serious disease which needs to be promptly dealt with. The disease first appears in the form of blackish green spots which afterwards increase in size and spread over the leaves, also the stems and the fruit. The infected parts assume a dark brown colour, and become parchment-like in texture, the leaves finally rolling up and hanging from the stems. Plants attacked are practically killed within a week. The dead leaves swarm with spores which are blown about by the wind. These spores will retain their vegetative powers and attack other tomato plants the following year. Both indoor and outdoor plants are liable to be attacked.

REMEDIES.—Once the disease has attacked plants badly the only remedy is to burn them at once and so prevent the spores being distributed. If the disease be noticed directly it appears spraying the plants with a 3 per cent. solution of Bordeaux Paste Mixture will arrest its progress. One spraying, however, will not suffice; it must be done every alternate morning for a couple of weeks at least. The soil, too, must be sterilised by mixing one barrow load of fresh lime with every five barrow loads of soil, and it must not be used again for tomatoes. The wood work, walls, glass, staging and paths should also be sprayed with carbolic acid, as advised for the Tomato Sleepy Disease.

Hadena Moth (*Hadena oleracia*).—The larvæ of this moth attack the fruits of tomatoes grown outdoors and under glass, gnawing holes into the flesh, both in a green

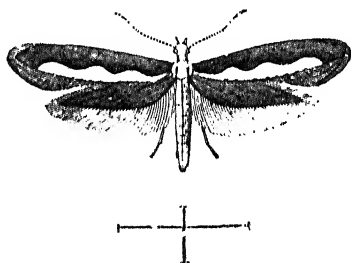
and ripe state. The moth appears in May and June, lays its eggs on weeds or on the tomato plants, and these in a short time hatch into caterpillars, which immediately commence to feed on the fruits or the leaves. The caterpillars feed mainly at night and hide during the day, hence they are not easily discovered except by searching for them at night. When very numerous they do a lot of harm to the leaves and fruit. The larvæ pupate in cocoons in the soil in August. See Coloured Plate.

REMEDIES.—The only practicable one is to search for the larvæ at night and destroy them.

Eelworms.—See Cucumber Pests.

TURNIP.

Turnip Diamond-back Moth (*Plutella maculipennis*).—The small caterpillars of this moth do very serious injury to the foliage of turnips, also cabbages, in some seasons. The moth is small and of a light brown or grey colour with three diamond-shaped marks on its wings seen when it is at rest. The moths first appear in spring and lay their white or yellowish-white cylindrical eggs on the



DIAMOND BACK MOTH
(*PLUTELLA*
MACULIPENNIS).

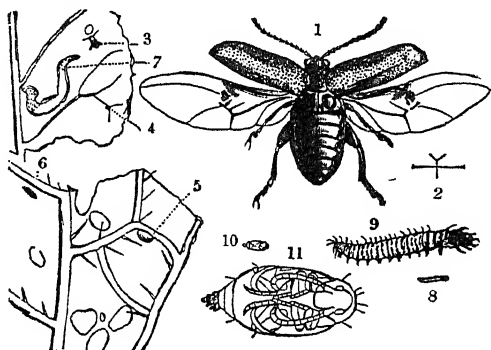
Moth (magnified). Lines indicate its natural size.

under sides of the leaves. The caterpillars are at first grey with black heads, but later change to a green colour with dark heads. Their bodies taper off to the tail and the head, and when fully grown average half an inch in length. There are two or three broods in a season. They pupate in creamy-yellow cocoons.

REMEDIES.—When the larvæ are discovered dust the

plants freely with a mixture of one part lime to three of soot. Spraying does not appear to do any good.

Turnip Flea Beetle (*Phyllotreta nemorum*).—The Turnip Fly, or Flea Beetle, is a small beetle about one-eighth of an inch in length, dark in colour, and with two white stripes down its back. It is an active little creature, and springs a good distance when disturbed. The beetles attack the seedlings of turnips, cabbage, swedes, etc., directly they appear above the ground, riddling the stems and leaves with holes and destroying the plants. They do



TURNIP FLEA BEETLE (*PHYLLOTRETA NEMORUM*).

1. Beetle magnified. 2. Lines to show natural size. 8 and 9. Larva (natural size and magnified). 10 and 11. Pupæ (natural size and magnified). 5. Etc., Leaf attacked.

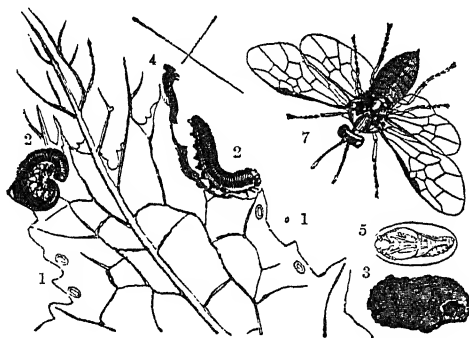
most harm on light soils and in dry seasons. When very numerous they will destroy the whole crop in a few days. The larvæ, hatched from eggs laid on the under sides of the leaves, also injure crops by boring into the tissues of the leaves and feeding thereon. See Coloured Plate.

REMEDIES.—The chief point to bear in mind is to encourage the seedlings to make vigorous growth from the first. This can be accomplished by the use of the artificial manures advised for turnips. The beetles will not interfere with the seedlings after they have formed their rough leaves. Other remedies are to fix some tarred sacks or sheets to a roller and then draw this over the ground.

This will pick up a very large number of the beetles. Dusting the plants with lime or soot early in the morning whilst the seedlings are moist with dew is a good remedy. Weeds, such as charlock, etc., should not be allowed to grow in the vicinity, as these form a harbour for the beetles.

Other Pests.—See Cabbage Gall Weevil.

Turnip Sawfly (*Athalia spinarum*).—The female insect, by means of its ovipositor cuts small slits in the under side of the leaves of turnip plants, and in each slit lays an egg. She lays from two to three hundred eggs in a season, usually from May to October. The eggs are hatched in from four to ten days. The black larvæ (known as "Niggers") feed upon the leaves of the in-



TURNIP SAWFLY (*ATHALIA SPINARUM*).

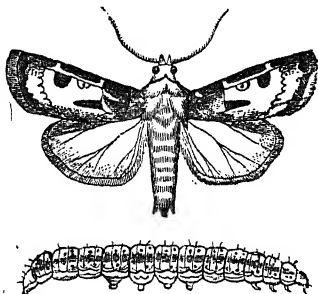
1. Leaf attacked by larvæ. 2. Larvæ. 3 and 5. Pupæ. 7. Sawfly, slightly magnified.

festated plants, which they reduce to mere skeletons of fibres. Whilst feeding they elevate their tails. In about twenty-one days the larvæ retire to the ground, where they spin cocoons, in which they are transformed into pupæ. In about three weeks the perfect insects appear, but if the pupæ are formed late in the season they pass the winter in the cocoons already alluded to, turning to the perfect state in the following spring or early summer. The perfect in-

sect is a black-and-yellow fly, with short feelers or antennæ. See Coloured Plate.

REMEDIES.—A new birch broom or a few small boughs tied together and drawn over the rows of plants will dislodge the larvæ. Once detached from the leaves, the larvæ appear to have no power to regain their position on them. Spray the foliage with a paraffin and soft soap emulsion, or a quassia and soft soap solution to destroy the caterpillars, and dress the ground with a soil firmigant to kill the pupæ. See Insecticide Formulæ, Part II.

Heart and Dart Moth (*Agrotis exclamacionis*).—The caterpillars of this common moth are exceedingly destructive to turnip, swede, and other vegetable crops. The moths have pale-brown and reddish-grey fore-wings and smoky-grey hind-wings. The moths appear in June and July, and lay their eggs on the plants close to the ground.



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HEART AND DART MOTH (*AGROTIS EXCLAMACIONIS*).

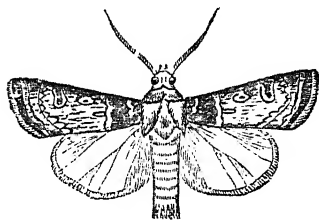
Moth and larva (natural size).

In two to three weeks the larvæ appear; they are of a dull grey colour with large black spots on their bodies. They feed chiefly at night and attack the roots and stems of plants beneath or just above the surface. They continue to feed throughout the autumn and winter, pupate in an earthen cell in spring and appear as moths in June.

REMEDIES.—Plants that look sickly should be pulled up when the larvæ will be found feeding thereon. In winter

the soil should be dug deeply and have lime and naphthalene sprinkled along the trenches as the digging proceeds. See Coloured Plate.

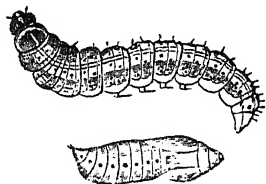
Dart Moth (*Agrotis segetum*).—Like the Heart and Dart Moth larvæ, those of the Dart Moth are equally destructive pests. The moth is very similar to the former. It appears in June, July, and August, lays its eggs on or near the plants, and in due course caterpillars make their appearance. They are of a pale smoky, pinkish, or purplish brown colour with a horny head and black jaws. When fully grown they are one a half inches long. At first the larvæ feed on the surface, biting the stems



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DART MOTH (AGROTIS SEGETUM).

Moth, Larva and Pupa (natural size).



off close to the soil. As they increase in size they descend into the earth and feed on the roots. Sometimes, too, they come to the surface at night and feed on seedlings, leaves of plants, etc. The larvæ continue to feed during the winter and spring, pupate in June and emerge as moths later on. Not only turnips, but also potato haulm, cabbage, and lettuce seedlings, etc., are damaged by the larvæ.

REMEDIES.—Hand picking and destroying the larvæ is the best method. Digging in a soil fumigant like naphtha-

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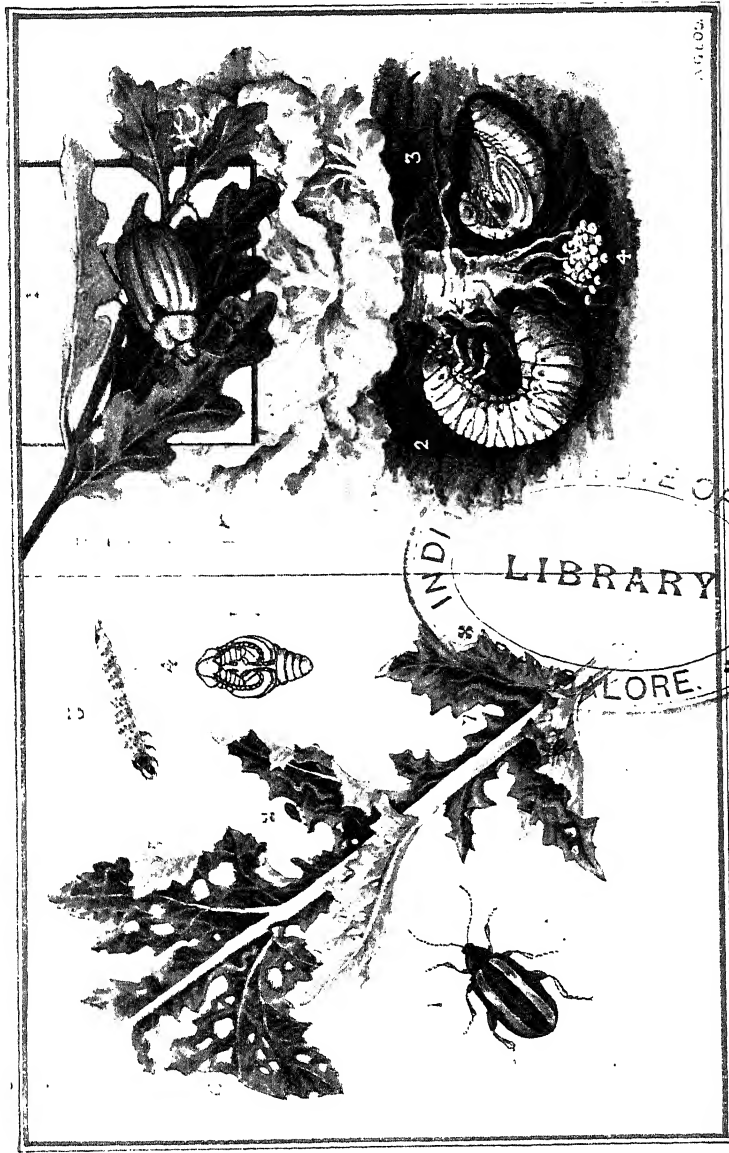
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COCKCHAFER BEETLE

(ANISOTOMA VITIGARIS.)

1.—Beetle (natural size). 2.—Larva at work. 3.—Pupa. 4.—Eggs laid in the soil. 5.—Line indicating $\frac{1}{2}$ length of the Beetle. (See A. 25.)

TURNIP FLEA BEETLE

(PHYLLOPHTA NEMORUM.)

1.—Beetle (largely magnified). 2.—Eggs. 3.—Damage done to leaves. 4.—Pupa (magnified). 5.—Eggs. 6 & 7.—Damage done to leaves. (See A. 92.)

TURNIP.

97

do injury by robbing the plant of sap, but also choke up the breathing pores of the foliage by covering the surface with a film of honeydew and excreta.

REMEDIES.—Spraying the foliage thoroughly with a soft soap and paraffin wash is the best way of getting rid of the pest.

Turnip Gall Weevil.—See Cabbage Gall Weevil.

VEGETABLE MARROW.

See Cucumber Diseases.

Part II.—MISCELLANEOUS DATA.

SPRAYERS AND SPRAYING.

To be able to use the insecticides and fungicides recommended in the foregoing pages to the best advantage the gardener must provide himself with an efficient apparatus. The old-time method of using an ordinary garden syringe or engine for the purpose no longer obtains, for science and experience have clearly demonstrated that if insecticides or fungicides are to act effectually they must be applied in a finely-diffused form—a very fine mist or spray—so that every particle of leaf or branch, or bud is thoroughly moistened. This effect cannot be obtained by means of any ordinary coarse-nozzled syringe. Besides, there is a great waste of liquid, and, where costly fluids are used, the application of insecticides or fungicides is under such conditions an expensive business.

Spraying Machines.—Nowadays a variety of apparatus specially designed to apply liquids in an economical, effectual way may be obtained in sizes adapted for spraying on a large or small scale, and those who wish to use insecticides or fungicides to the best advantage should certainly make it their business to acquire a suitable one.

The most useful and handy sprayer for small gardens and greenhouses is a good syringe fitted with adjustable nozzles capable of diffusing liquids in a coarse, medium, or very fine spray. Such a syringe will serve the general purpose of spraying plants or seedlings with clean water for cleansing or refreshing the foliage; also for the application of insecticides and fungicides to infected plants. There are several forms of syringes of this character in commerce, particulars of which will be found in the pages of "Amateur Gardening."

Then there are also several kinds of hand pneumatic sprayers capable of holding liquids from a pint upwards, which are discharged in a mist-like form by means of com-

pressed air. The simplest form of sprayer of this character is a bottle fitted with a metal tube and an india rubber ball or bag, such as is used by hairdressers. Such a sprayer answers all right for spraying small plants. Another and still more useful sprayer for use in the garden is a brass or nickel apparatus, fitted with an air pump and a chamber capable of holding four pints of liquid. In this case the insecticide or fungicide is first poured in and the orifice securely closed and then a few strokes given by the air pump to charge the apparatus with compressed air. By turning a tap attached to the delivery nozzle the air then forces out the liquid in a fine spray.

Yet another type of sprayer is the hand pump. This consists of a suction tube of metal or rubber placed in an ordinary pail, a delivery metal or rubber tube, and a piston fitted with a crutch or a metal crank handle. At the base of the main cylinders is a foot rest for the operator to stand on whilst using the piston. One hand in this case works the latter, while the other is employed in holding and directing the spraying tube and nozzle. Such an apparatus is suitable for spraying dwarf fruit trees, roses, or for syringing wall fruit trees.

Still more useful for general spraying potato crops is the knapsack sprayer. There are many different kinds on the market. They are made of copper or tinned copper, and fitted with straps so that they can be carried on the back of the operator. Their average weight when empty is about 14lbs., and they hold $3\frac{1}{2}$ gallons of liquid. They are fitted with air chambers and internal or external air pumps. The pumps in this case are worked by the operator by one hand, while the other is employed in directing the delivery tube and nozzle. Each is provided with a short length of hose and a brass lance 3 feet long to which the nozzle is attached. For tall trees a bamboo lance 5 feet long is used. Some forms of knapsack sprayers are worked by compressed air forced into the air chambers beforehand. They are fitted with a pressure gauge, and also a safety valve. These are termed "pneumatic sprayers." It is only necessary in their case to turn a tap to discharge the fluid.

Care of Spraying Machines.—All machines im-

mediately after use should be thoroughly rinsed out with water to remove all traces of the fungicide or insecticide. Great care must be taken to see that no grit is present in the nozzles. The working parts should also be well lubricated with good machine oil; the washers, too, should be oiled and also the straps. It is very important that these points should be carefully attended to each time after use. It is also most essential to pass the liquids through a fine strainer when charging the tank.

How to Spray.—See that the mixtures or fluids are thoroughly well mixed before using. When coarse materials enter the composition of the fluids it is advisable to strain the liquids at least twice through a fine strainer before using; otherwise grit or other particles may get into the spray nozzles and prevent the efficient working of the apparatus.

Whether applied with a spraying machine or with a syringe, always see that the liquid is delivered in a mist-like diffusion, so that it effectually coats the upper and under sides of the leaves with a thin film of moisture.

SPRAYING POTATOES.

WE have already alluded in the section devoted to the foes of the potato to the importance of spraying the foliage with a fungicide as a preventive remedy for ensuring immunity from the attack of the Blight Disease (*Phytophthora infestans*). It must be clearly understood that spraying is only a preventive remedy, and not a cure. Once the foliage is badly attacked spraying is of no service as the mischief is wrought, but if it be carried out before the disease appears then it will accomplish much good in preventing any spores that may fall on the foliage from vegetating, and thus save the plants from attack. There is no doubt that the timely spraying of the foliage repays well for the trouble and expense involved. It has the merit of keeping the foliage healthy, and thus enables growth to proceed unchecked, with the result that heavier and healthier crops are obtained. In the various trials made during the last two or three years it

has been proved that the average increase of yield of tubers has been $1\frac{1}{2}$ tons per acre from sprayed over unsprayed ones. So this shows the wisdom of spraying second early and late crops.

Time to Spray.—The Ministry of Agriculture advise the first spraying to be carried out the last week in May in the Penzance district; the first week in June in the forward districts of Cornwall, Devon, and the Isle of Wight; June 15, in other parts of Cornwall, Devon, Dorset, Hampshire, Somerset, and South Wales; July 1 to 8 in Glamorganshire, Gloucestershire, Monmouthshire, N.W. Wales, Sussex, and Wiltshire; July 8 to 15, in Berkshire, Herefordshire, Kent, Oxfordshire, Surrey, and Worcestershire; July 15 to 31, in the remainder of the country; and in the north-eastern counties, the last week in July. A second spraying is advised three weeks later, and a third spraying a few weeks later in the south-western counties, or other districts where the rainfall is heavy.

INSECTICIDE FORMULAE.

Following are recipes for making various insecticides referred to in Part I. :—

NAPHTHALENE.

CONSTITUENTS.—A whitish, glistening, flaky powder with a strong odour. A bye-product from coal distillation. Also slaked lime.

QUANTITIES.—One part of naphthalene to fifteen parts (by weight) of lime. Mix thoroughly.

USES.—As a soil insecticide for destroying Carrot Fly larvæ, Leather Jacket grubs, in the soil.

How to APPLY.—Dig it in deeply at the rate of 40zs. per square yard.

WHEN TO APPLY.—In autumn or winter.

SOFT SOAP AND QUASSIA WASH.

CONSTITUENTS.—Quassia chips, soft soap and water. Non-poisonous.

QUANTITIES.—Quassia chips, 1lb. ; soft soap, $\frac{1}{2}$ lb. ; water, 10 gallons.

PREPARATION.—Boil the quassia chips in water for two hours, then strain off the liquor. Dissolve the soap in hot water, mix the quassia extract with it, then add water to make 10 gallons. Another method is 1lb. quassia chips, 1lb. soft soap, and 10 gallons of water. Boil the quassia with half the soap in some of the water for an hour, then with the rest of the soap and some fresh water for another hour. Combine the two solutions, and make up to 10 gallons with water.

USES.—To destroy cabbage and bean aphides, Cabbage Powderwing Fly.

WHEN TO APPLY.—Summer.

CARBON BISULPHIDE.

CONSTITUENTS.—A colourless, highly inflammable, and poisonous liquid.

USES.—As a soil insecticide for destroying weevils, millepedes, springtails, or larvæ living in the soil.

How to APPLY.—Make holes 6in. deep and 2ft. apart. Use 4 oz. for each square yard. Immediately seal up the hole by stamping down the soil with the foot.

WHEN TO APPLY.—In dry weather only.

SPECIAL PRECAUTIONS.—Do not inhale the fumes, nor smoke whilst applying the carbon.

LEAD ARSENATE PASTE.

CONSTITUENTS.—Arsenate of lead sold in paste form in jars, and water.

QUANTITIES.—Paste, $\frac{1}{2}$ -lb.; water, 10 gallons.

USES.—Destroying the larvæ of the Asparagus Beetle, Beet Carrion Beetle, Pea Weevil, etc.

WHEN TO APPLY.—In summer.

SPECIAL PRECAUTIONS.—Must not be used to spray any other vegetable crops. Very poisonous, therefore the surplus liquor should be emptied down a drain, and the vessel well washed after use.

PARAFFIN AND SOFT SOAP EMULSION.

INGREDIENTS.—Paraffin oil (Solar Distillate, or White or Tea Rose brands), soft soap, and water.

QUANTITIES.—Paraffin, 1 quart; soft soap, $\frac{1}{2}$ -lb.; water, 10 gallons.

PREPARATION.—Dissolve the soap in boiling water, and when this is accomplished, add the paraffin and stir or churn with a syringe the whole vigorously until a creamy emulsion is obtained.

USES.—To prevent Celery Fly laying its eggs on celery.

WHEN TO APPLY.—May and June.

CARBOLIC ACID AND SOFT SOAP.

INGREDIENTS.—Carbolic acid, soft soap, and water.

QUANTITIES.—Carbolic acid, 1 pint; soft soap, $\frac{1}{2}$ -lb.; water, 10 gallons.

PREPARATION.—Dissolve the soft soap in boiling water, add the acid and remainder of water, and stir thoroughly.

USES.—To prevent Celery Fly laying its eggs in the leaves, also for destroying Cabbage Root Fly larvæ.

FUNGUS FORMULAE.

Recipes for making fungicides referred to in Part I.:—

BORDEAUX MIXTURE.

This is a well-known and widely used fungicide for diseases caused by microscopic fungi. Poisonous.

INGREDIENTS.—It was formerly the practice to prepare a mixture of 2lbs. of copper sulphate; 2lbs. of freshly burnt lime; and 10 gallons of water, but unless prepared with great care the mixture often seriously injured the foliage. Thanks to the late Mr. Spencer Pickering, F.R.S., a much safer and less complicated mixture can be made by the use of Woburn Bordeaux Paste. It is, moreover, less costly than the old mixture.

QUANTITIES.—Woburn Bordeaux Paste, $1\frac{1}{2}$ lbs.; water, 7 gallons.

PREPARATION.—Dissolve in water, then use.

USES.—For Potato Disease, Tomato Leaf Spot, Asparagus Rust, Plant Bugs, etc.

WHEN TO APPLY.—Summer.

BURGUNDY MIXTURE.

A fungicide used in place of Bordeaux Mixture for spraying purposes. Poisonous.

INGREDIENTS.—Sulphate of copper (98 per cent. purity); washing soda (98 per cent. purity); and water.

QUANTITIES.—Sulphate of copper, 1 lb.; soda, $1\frac{1}{2}$ lb.; water, 10 gallons.

PREPARATION.—Dissolve the sulphate of copper in one gallon of water in a wooden, not a metal vessel. Dissolve a gallon of water in another vessel the soda, and when the copper is dissolved pour the soda solution into it and add water to make 10 gallons. The mixture should be a bright blue in colour and be used as soon as made. The solution must be well stirred at the time of mixing.

USES.—For prevention of Potato Blight, Tomato Leaf spot, and Asparagus Rust.

WHEN TO APPLY.—Summer.

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SPECIAL PRECAUTIONS.—Must be applied to the under as well as the upper sides of the foliage. Vessels used for mixing must not be employed for food purposes as the solution is poisonous.

SULPHIDE OF POTASSIUM.

This is commonly known as Liver of Sulphur. An excellent fungicide for mildews.

QUANTITIES.—Sulphide of potassium, 3oz.; soft soap, 4oz.; water, 10 gallons.

PREPARATION.—Dissolve the potassium and the soft soap separately in water, then mix the two, and add water to make 10 gallons. Mix thoroughly.

USES.—For Tomato Leaf Rust, Pear Mildew, Onion Mildew, Cucumber Leaf Spot.

WHEN TO APPLY.—Summer.

SPECIAL PRECAUTION.—Should be used in a fresh state.

THE STERILISATION OF SOILS.

SCIENTISTS tell us that in all soils there are trillions upon trillions of micro-organisms (Bacteria), some of which are helpful to the plants growing in the soil, and others which are distinctly harmful to plant life. The aim of the cultivator, therefore, should be to encourage the former whilst aiming at the destruction of the latter. One of the chief difficulties lies in the fact that, to kill the harmful bacteria you also kill the useful microbes, in just the same way as the ignorant application of a can of weed-killer to a lawn would be fatal to grass, as well as daisies and dandelions.

And it is not only harmful bacteria that the gardener has to contend with in the soils and composts used for the cultivation of favourite plants and essential food crops, but also myriads of spores of fungal diseases, microscopic enemies like eelworms and so on, that are lying in wait in readiness to attack seeds, seedlings, etc. There are, moreover, many kinds of weed seeds present in soils that are required for rearing ferns from spores, and which, if the precaution be not taken to sterilise them beforehand, would choke the tiny ferns in the early stages of their growth and cause grievous disappointment to the grower. Hence it will be seen that if we wish to attain success in rearing or growing plants or crops successfully, we must take the precaution to adopt some method of sterilising the soil.

Now, what is sterilisation? From a gardening point of view it means heating or steaming the soil, or treating it with some chemical that, while destroying harmful bacteria, fungal spores, microscopic creatures and insect ova, will not at the same time kill the beneficial bacteria, nor yet destroy the organic matter in the soil and so render it sterile so far as plant food is concerned. If we were to adopt the advice sometimes given of placing compost on a shovel, in a pail, or in a boiler, and heat it say, to a temperature of 200 deg. Fah. or more, we should do more harm than good; we should destroy all bacterial life and also all organic matter, thus rendering the com-

post practically useless. We must, therefore, exercise care in carrying out sterilising.

By Formalin.—Undoubtedly one of the best fumigants for outside use is formalin (formic aldehyde). This substance, as sold commercially at 40 per cent. strength, is a pungent liquor which must be diluted greatly before use, yet it is one which may be made up in quantity and employed at any reasonable date hereafter, i.e., it does not depreciate in quality. Any strength may be employed to within five weeks of planting, but the most economical solution is made by pouring one pound of the liquid into ten gallons of water. The ground should be dug up before this fumigant is applied, but it is none the worse for having had time to settle previous to its use. It may also be used when digging is going on, every second trench being wetted with the prepared liquid; one gallon we look upon as sufficient for 3—5 square yards, according to the nature of the soil; but a less thorough spraying than this admits of greater economy. No matter what method is employed, the surface should be raked loose and then trampled firm after application, this operation being quite sufficient to conserve the fumes. The surface of soil so treated should be covered for a week with mats, sacks, or tarpaulin sheets to prevent the fumes escaping too readily into the air.

By Ammonia Solution.—Ammonia solution is only to be used when insects are the depredators. One pound in five gallons of water, used in the above way, will clear out almost all insect pests.

By Carbolic Emulsion.—More success has attended our trials with carbolic preparations, but it must be understood from the very first that it is the safest plan to use them only on vacant plots, and never to plant out until six weeks have elapsed from the time of application. A good emulsion can be prepared by pouring one gill of commercial oil into eight gallons of water containing one ounce of soap to the gallon; hot water is best to use in the preparation, and thorough agitation is necessary to secure perfect emulsification. Do not let this emulsion stand too long without stirring up, but, if the agitation is kept up, the mixture will not depreciate in any way. It is a very

cheap preparation and highly efficient. It can be sprayed over the ground before digging commences, or employed as advised for formalin.

By Steam or Hot Water.—One of the safest agents to use for the sterilisation of a soil, whether in large or small quantities, is heat—either dry or moist. Thus, it comes about that large growers, with thousands of feet of glass, now use frames of perforated pipes, through which steam from a boiler can be forced. The frame is taken into a long cucumber or tomato house, and a section of the soil is piled over the pipes, covered with canvas, mats, or similar material; steam is turned on at about 60 or 70 lbs. pressure per square inch, and the soil is quickly saturated with boiling steam, and everything, whether animal or vegetable, is killed; and so the process is repeated until the whole of the soil has been sterilised. The soil, after a period, again becomes inoculated with bacteria, and, being in a pure state, the useful microbes flourish to such a degree that plants put into such a soil quickly outgrow their neighbours planted in an untreated medium. Such an outfit as described above is out of the reach of the amateur, but the method of applying moist heat can be imitated by pouring boiling water on soil for seed-sowing, potting up, and cutting-striking purposes with such results as will quickly convert the most inveterate “stickler” to old-time methods.

By Heat.—Sterilising by dry heat may be done in several ways, all more or less beneficial, according to the degree of application to which they have been pushed. A barrow-load of soil put in a large bath, or any metal vessel capable of holding it, if set upon a few bricks, admits of a fire being lit underneath, and the soil slowly baked, but yet not intensely heated. If the top of the vessel was well covered with sacks, or some non-heat conducting material, the lower portion of soil would be baked, and the steam from that would sterilise the upper portion, thus lessening the amount of fire that would be required to bake the mass right through. During the process of heating stir the soil occasionally so that the heat is equally diffused through the whole mass. Small quantities may be baked on a shovel, or a few old fire bars, made red-hot

in the furnace, or fire-bricks can be buried in small heaps of soil, and after about two hours taken out; the heap should then be thoroughly turned up together, with the consequence that the whole is rendered very much more suitable for plant life. All composts intended for rearing plants from seed should be treated thus before the seeds are sown.

By Lime and Sulphur.—Lime is so commonly used in gardening that we have come to look upon it as indispensable. Mixed with sulphur, its insecticidal, fungicidal, and bactericidal power is increased; the two may be applied separately or together, but the sulphur should be in the ground a month before the plants are there—not as an absolute necessity, but as a precaution. One pound of sulphur to fourteen of lime will serve, but we always apply them separately, the lime in autumn and the sulphur in January, 4 to 8 ounces per square yard is the total dressing—the amount being determined by the nature of the soil. It must be understood, however, that lime-sulphur is much inferior to the previous-mentioned chemicals as a steriliser.

A Good Soil Fumigant.—There are several excellent soil fumigants in commerce which are used for the destruction of soil grubs, spring tails, and other pests. A good home-made one, however, consists of one part of naphthalene and fifteen parts of ground lime. Mix the two together and when digging the soil scatter it along the bottom and sides of the trench at the rate of 4 oz. per lineal yard.

